THE

JOURNAL

OF

GAS LIGHTING,

111691

WATER SUPPLY,

Etc.

VOL. LXXVII.

JANUARY TO JUNE, 1901.

LONDON:

WALTER KING,

11, BOLT COURT, FLEET STREET, E.C.

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXVII. No. 1964.] LONDON, JANUARY 1, 1901. [53RD YEAR. PRICE 6d.

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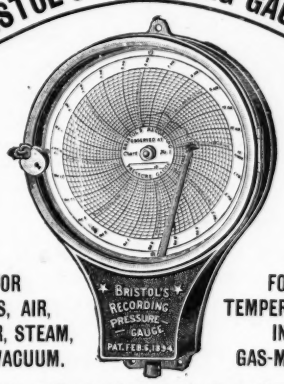

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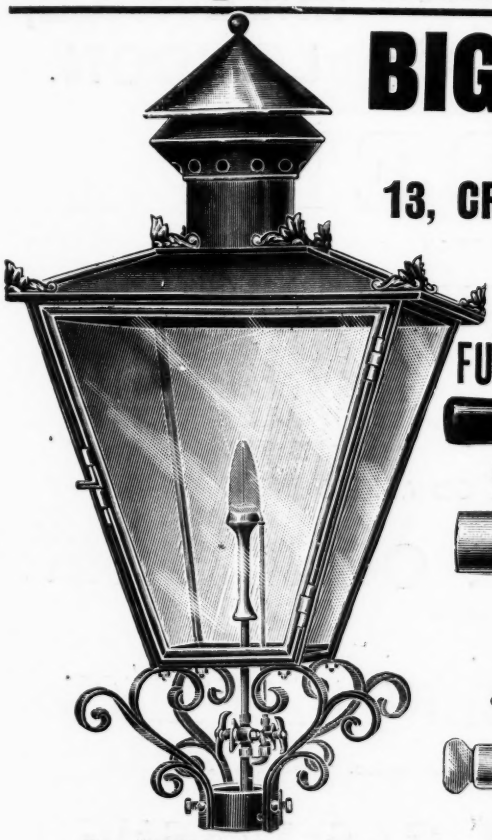

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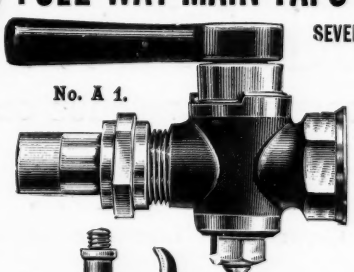
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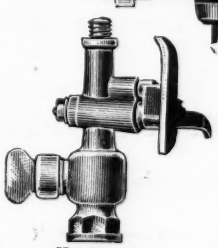
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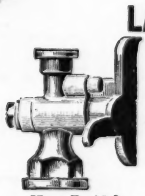
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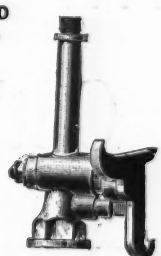
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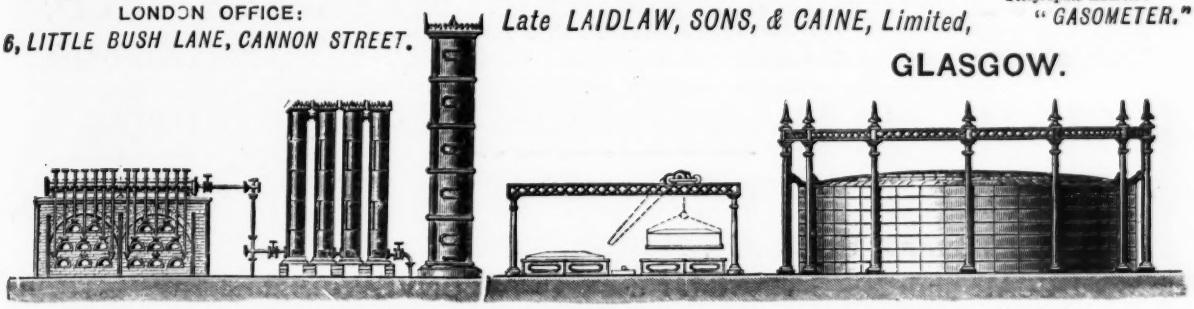

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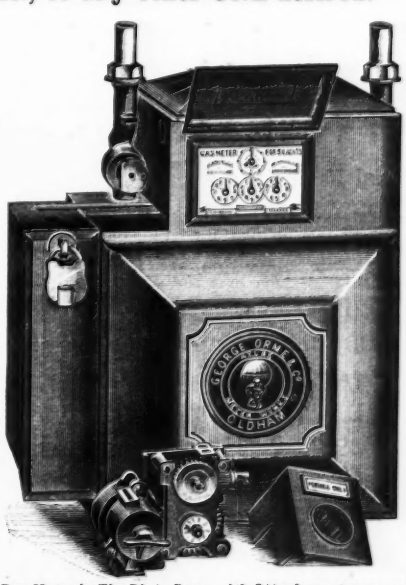

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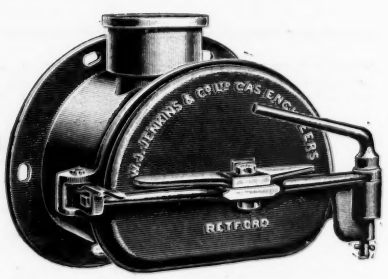

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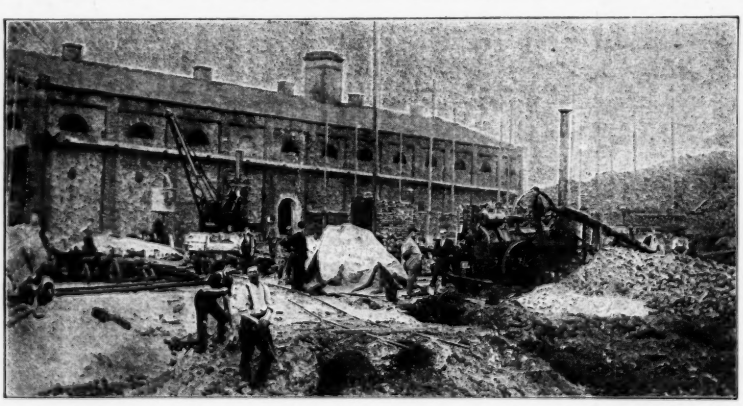

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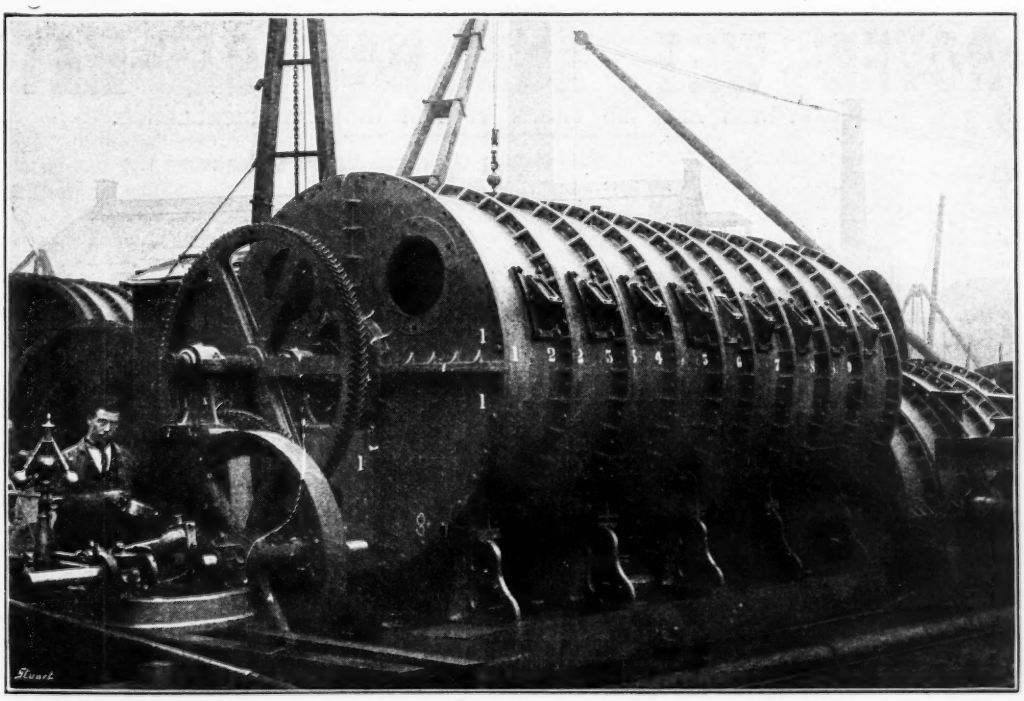
All Sizes from 50,000 to 5,000,000 Cubic Feet of Gas per Day.



The "NEW" Scrubber-Washer can be arranged to suit all cases of the Washing of Gases with Liquids.

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Cubic Feet of Gas per day are now being Purified by

PATENT "STANDARD" WASHER-SCRUBBERS

which extract ALL the Ammonia and a large proportion of the CO_2 and H_2S.

Prevention of Slip of Gas Unwashed.

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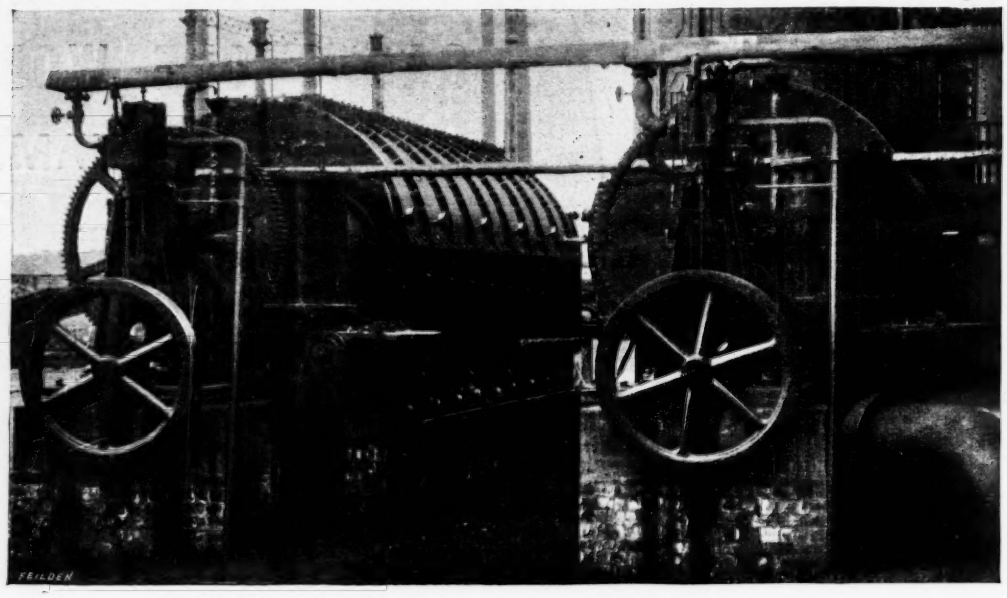

Maximum Washing Surface.

Easy access to interior.

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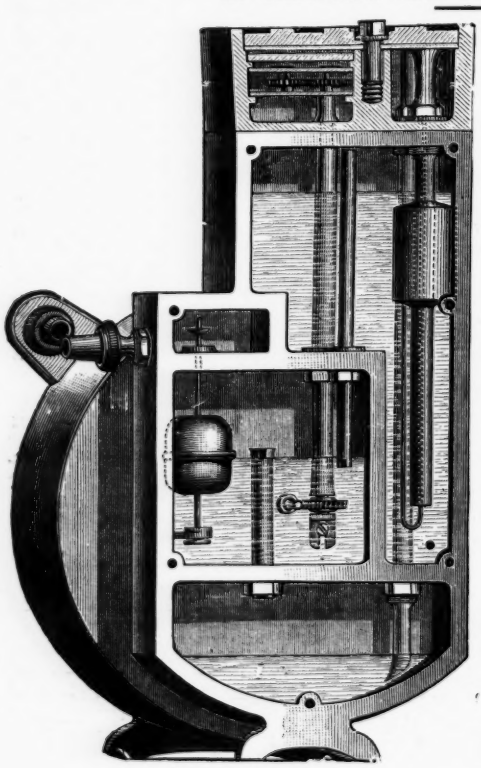

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GREEN'S PATENT
UNDERGROUND METER

Has been designed to obviate that which has hitherto prevented the general adoption of underground Meters—namely, their serious cost. No box is required; and the saving thus effected as compared with ordinary underground Meters, where either a box or meter-pillar is necessary, is fully one-half. The price of one for three lights is 28s.; and the other sizes are correspondingly cheap. When fixed, the only part of the Meter exposed to view measures 6½ inches by 8½ inches. By the Indicator with which the Meter is fitted, the Inspector can at once discern whether water is required; but as the Meter is of the compensating description, water will probably need only be supplied ONCE A YEAR. It is advisable to fill the Meter with a non-freezing liquid which does not injure the fittings; and this can be supplied at about 1s. 3d. per gallon.

Prices and all Information on Application.

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Belfast	1,700,000	Bordentown, N.J.	125,000	Commercial (2nd)	850,000
Belfast (2nd)	4,500,000	Winchester	225,000	Commercial (3rd)	1,250,000
Brussels-Ville	750,000	Shanghai	225,000	Rotterdam	850,000
Brussels Ville (2nd)	750,000	Stockport	600,000	Dorking	150,000
Liverpool	3,500,000	Norwich	1,000,000	McKeesport, Pa.	500,000
Liverpool (2nd)	4,500,000	Holyoke, Mass.	600,000	G.L.&C.Co., Bromley	3,750,000
Tottenham	750,000	St. Joseph, Mo.	750,000	G.L.&C.Co., Nine Elms.	2,750,000
Tottenham (2nd)	750,000	Lea Bridge	350,000	Durham	200,000
Santiago de Cuba	400,000	Lea Bridge (2nd)	350,000	New York	4,000,000
Swansea	750,000	Stockton-on-Tees	500,000	Scarborough	800,000
Manchester	3,500,000	Edinburgh	2,000,000	Perth, W.A.	125,000
Brighton	1,750,000	Guildford	350,000	Bremen	550,000
Preston	1,400,000	Brentford	1,200,000	Maidenhead	225,000
New York	1,200,000	Syracuse, N.Y.	850,000	Epsom	225,000
Southport	750,000	Bridlington	150,000	North Middlesex.	150,000
Bath	1,000,000	Middlesbrough	1,250,000	Wandsworth	1,800,000
Newburg, N.Y.	350,000	Croydon	1,250,000	Aarhus	800,000
Newburg (2nd)	250,000	L. & N.W. Ry., Crewe	700,000	Falmouth	150,000
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Hartlepool	750,000	Stockport (2nd)	600,000	Faversham	200,000
Utrecht	1,000,000	Croydon (2nd)	625,000	Birmingham (Swan V'ge)	1,500,000
Deventer	150,000	Maidenhead (2nd)	225,000	St. Gallen (Switz.)	225,000
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Aylesbury	150,000	Tottenham (3rd)	350,000	Tunbridge Wells	1,000,000
Hamburg	1,750,000	Sydney (Harbour)	500,000	Hebden Bridge	200,000
Redhill	275,000	Sydney (Mortlake)	500,000	Chorley	300,000
Dublin	2,000,000	Manchester (2nd)	3,500,000	Liège	1,000,000
Posen	450,000	Hull	1,500,000	Stafford	500,000
Dunedin (N.Z.)	150,000	Longton	600,000	Bridlington (2nd)	200,000
Lincoln	500,000	Staines	600,000	Gosport	200,000
Antwerp	1,500,000	Commercial (4th)	2,000,000	G.L.&C.C., Beckton (2nd)	10,750,000
Brussels-Forêt	1,000,000	Dublin (2nd)	2,000,000	Tottenham (4th)	1,000,000
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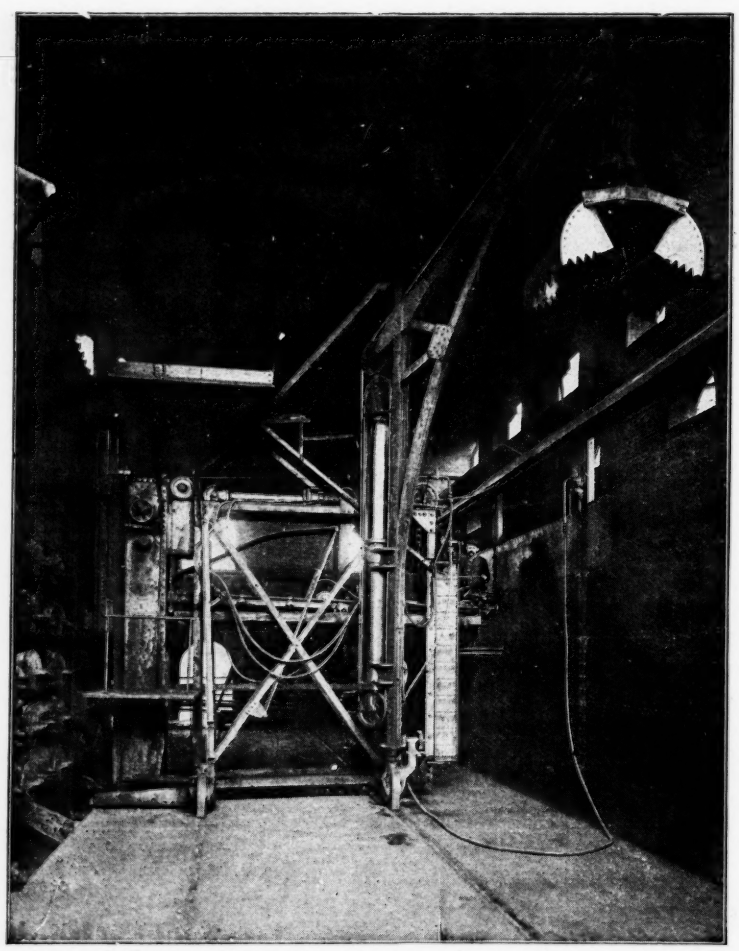
EDINBURGH GAS-WORKS.

LIVERPOOL GAS-WORKS.

BRIGHTON GAS-WORKS.



WAPPING GAS-WORKS.

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BRITISH GAS CO.—
Hull.

BOLTON GAS-WORKS.

IMPERIAL CONTINENTAL GAS ASSOCIATION—
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Vienna.
Berlin.

HAGUE CORPORATION GAS-WORKS—
Hague.

METROPOLITAN GAS-WORKS—
Melbourne.

CLEVELAND GAS-WORKS—
Cleveland, Ohio,
&c., &c., &c.

NEARLY
300 MACHINES
ARE AT
WORK OR IN COURSE OF CONSTRUCTION.

THE TIME TAKEN TO DRAW AND CHARGE EACH RETORT BY THESE MACHINES AVERAGES

UNDER ONE MINUTE.

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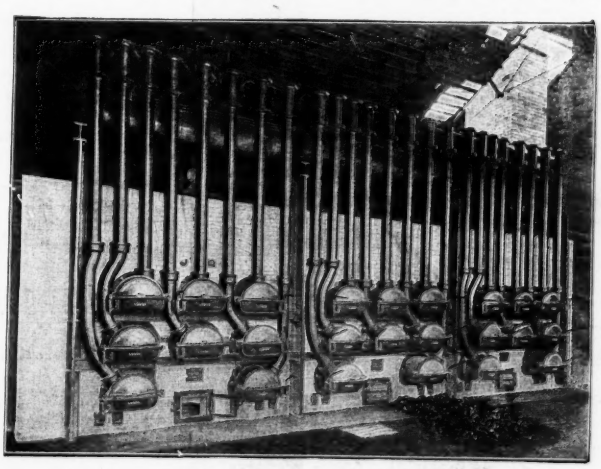

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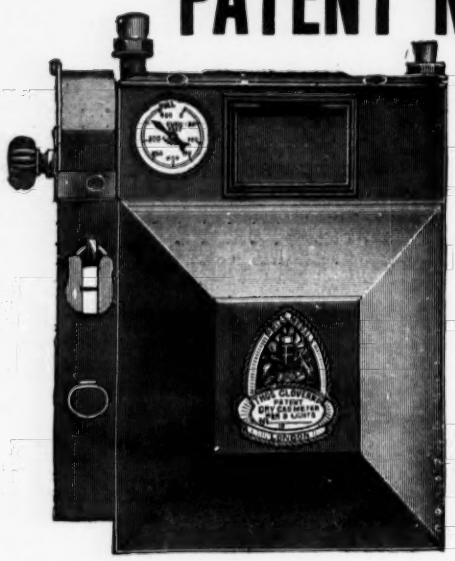

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JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

VOL. LXXVII., No. 1964.——TUESDAY, JANUARY 1, 1901.

EDITORIAL NOTES.

The Bill of the Gaslight and Coke Company.

THE Bill of the Gaslight and Coke Company for the ensuing session of Parliament will be found summarized in another column; and it is therefore now possible to appreciate the nature and extent of the concessions to opposing forces, in and out of Parliament, which the Directors of the Company are prepared to offer, according to the terms of the notice mentioned in this column on Nov. 20 last. It is necessary to bear in mind the fact that this is the third Bill promoted by the Company within three years, with the main object of obtaining permission to raise the additional capital declared to be necessary for carrying on the undertaking. It would be superfluous for us to repeat the history of the two earlier measures, or to state the reasons why Parliament rejected them. Suffice it to remark that the recorded experiences of the past two years have now chastened the Horseferry Road sufficiently to render possible the proffer of the present suggestion for reconstructing the whole financial system of the Company more in the spirit of the recommendations of the Powers of Charge Committee of 1899 than would otherwise have been deemed expedient. The demand for fresh capital has been cut down to a round million, which is to be raised by auction or tender in the open market, not at a fixed price. It is to be in the form of a second three per cent. debenture stock ranking next after the existing three per cent. consolidated debenture stock. Thus, no sooner has the Company's debenture capital been consolidated, than the "sweet simplicity" of the single class of such stock is to be broken. Presumably there are reasons for this reversion to a state of things which was abolished in 1898; but they are not mentioned.

The great interest of the Bill—that which constitutes the present attempt on the part of the Company a "sporting" offer" to meet the expressed opinion of Parliament—is disclosed in clause 7, which we reproduce nearly *verbatim*. This proposal is that, out of the profit balance of any "calendar year" applicable to the payment of dividend to the holders of ordinary stock, there shall first be payable a dividend at the rate of 4 per cent. per annum. This is equivalent to the old maximum 10 per cent. dividend on the unconverted original capital stock, the principle of which it seems to revive and confirm. Then, if there is any profit balance left over, and if the price of gas has been such as to permit of the division of any of this surplus profit as sliding-scale dividend, before such extra dividend is made an allowance up to 5s. per cent. upon the nominal total amount of the consolidated stock (both issued and unissued) is to be taken out to form a stock redemption fund. This allowance is equivalent to 12s. 6d. per cent. on the original unconsolidated stock. Subject to this charge, the Company may pay extra sliding-scale dividends, if they have earned and are entitled to them. Only, the reserve fund of the Company is not to be drawn upon for the purpose of making up the year's dividend in excess of 4 per cent. This last self-denying ordinance appears to be a huge measure of repentance for the sin of dividend-grabbing, if it means, as it seems intended to do, that excess sliding-scale dividends are only to be payable if the money has actually been earned. It is proposed that, during the year following the allocation of any money as aforesaid to the redemption of capital, the corresponding amount of stock shall be purchased and cancelled.

It is not too much to say that this scheme, which will attract the curious attention of everybody who is in any way interested in the matter, has been drafted with extreme cleverness to suit the immediate circumstances of the Gaslight and Coke Company, while offering a solution of the puzzle left over in the recommendations of the Powers of Charge Committee. That Committee thought the obsolete capital of the Company should be written off, but omitted to specify how this could be done. Obviously, this operation can only be acceptably carried out at the expense of the proprietors, out of money otherwise available for dividends. This is the offer now made, in a manner to which no exception can be fairly taken. The Company are willing, they say, to resume in a sense, and for this purpose, their old *status* of a 10 per cent. maximum undertaking; giving the first quarter per cent. of excess lawful dividend to the purpose of redemption. Having regard to the unprecedented conditions of the case, this allowance does not compare at all unfavourably with the rate of redemption prescribed for first municipal gas loans. Besides, it is not until after this money has been set aside, that the Company will be able to distribute any excess sliding-scale dividend to which the existing Acts may entitle them, and which may have been legitimately earned the same year. Clearly, this constitutes a strong reinforcement of the incentive to effort which the sliding-scale is supposed to create. Looked at in another light, it is tantamount to reducing the initial price of 3s. 9d. by 2½d.—another approximation to the wishes of the Powers of Charge Committee. It would be unkind to lay too much stress on the disappearance of the reserve fund before making the offer not to pay any more excess dividends out of it. As we have already remarked of the Company's counsels, it is never too late to mend.

Altogether, therefore, whoever is responsible for the new Bill is to be congratulated upon his performance. The Directors, also, appear to profess in every line their intention to be "very good" for the time to come; and it would be hard-hearted in an extreme degree to reject their promise of amendment on account of old scores. Still, there are plenty of callous critics of the Horseferry Road Administration who will insist upon looking this new "gift horse" very carefully "in the mouth" before making up their minds as to its acceptability. Besides, a Bill has not only to be framed—it requires to be carried through; and this is a process needing a good deal of tact.

Coal Prices in the Coming Year.

WE publish elsewhere to-day the annual report of our Special Correspondent on the Lancashire Coal Trade, and also a general survey of the various aspects of the coal problem during the past eventful year. With the bygones of the question those articles deal as fully as needs be, until the complete statistics of the twelve months come to be recorded. Our concern here is now with the present and the future; and the purpose of writing, that of urging upon the gas industry the wisdom and necessity of refraining to the uttermost from playing into the hands of coalowners. Let this be first and emphatically said—that there is no fear of the supply of coal being inadequate to meet the demand during the year now before us, except in the event of a serious strike or lock-out. Even should the owners decide upon, and all agree to carry out, the disastrous policy of materially reducing their output in order to maintain artificially the high prices of coal (and we do not believe that they will be so foolish), there would be this radical difference between the then situation and that of a year ago—namely, that whereas then the existing output arrangements when worked to the full were insufficient to supply the market requirements, the possible output of the now available seams is more than equal to the demand. Money would, therefore, be able, in the last resort, to procure what it was impotent to obtain last spring—ample supplies of coal. The danger involved in playing a waiting game is accordingly reduced to a minimum.

The wisest policy, then, that can be adopted by coal buyers at the present time is that of keeping their purchases down to the lowest possible figure, and of refusing to commit themselves to long-period contracts, unless they be offered coal at materially lower figures than those now being quoted by the collieries. Moreover, the same advice applies to iron and steel goods. We have been urging upon our readers consistently for the last eighteen months the policy of abstention from buying plant and structural material generally until the advent of normal prices, except under the stress of necessity; and it is satisfactory to know that (whether in consequence of our advocacy or not is immaterial, and we make no claim for credit) this course has been very widely, though not universally, followed. The result of this attitude of consumers, and of the inroads of foreign competition, is

that the "boom" in the iron and steel trades has collapsed in a sudden and most striking manner; and the present moment finds manufacturers, who a year ago were daily refusing work, with practically clear order-books. Prices are consequently dwindling steadily, but are not yet by any means low enough to justify buying.

Indeed, any considerable access of fresh business to the metal and engineering industries just now would be most inopportune, as tending to retard the downward movement of coal prices. So long as the iron makers find it impossible to obtain fresh orders at ruling prices, and equally impossible to lower these prices because of the costliness of fuel, so long will there be serious pressure brought to bear upon the coalowners to readjust the market. The railway companies have, it is true, succeeded in obtaining more considerable concessions from the collieries than the owners were at first disposed to grant; but it is to be earnestly hoped that industrial consumers of coal generally will not accept the sales now reported as having been made to the railways as representing the best terms that will be on offer, or obtainable, during the year now opening, and that they will not create an "inevitable" by accepting it.

The railway contracts have in most cases been made for only six months from to-day; and, whereas the collieries offered in the first instance a reduction of 1s. a ton from previous rates, the companies are now reported to have obtained a total concession of about 2s. or 2s. 6d. per ton. This leaves the price at 12s. 6d. to 13s., as against 8s. to 8s. 6d. two years ago, or about 50 per cent. above normal prices. It is, therefore, not in the least surprising to read that this reduction is viewed, not only by the railway companies, but by industrial circles generally, with very great dissatisfaction. No one who has not carefully studied the detailed reports that are to be found weekly in the various trade journals, or has failed to digest the elaborate annual reviews of the past and present state of trade that have been published in the newspapers during the past few days, can adequately realize the enormous damage that has been done to the business of this country by the exorbitant prices that have obtained for coal and iron in the year just closed. We would specially advise anyone who needs, and desires, enlightenment upon the subject to read, mark, learn, and inwardly digest the reports from various leading firms in Scotland published by the "Glasgow Herald" last Thursday, to which we shall probably take occasion to refer more fully in a subsequent issue.

If the coalowners are not altogether blind to their true interests—and there is no reason to believe them to be endowed with a double dose of original sin (speaking in an economic sense)—they must be as anxious as anyone that trade should continue prosperous; and they must be singularly ill-informed if they do not realize that the only measure that can save the country from being plunged into a period of severe industrial depression, is the prompt and material reduction in the price of coal. We say this, not simply because such reduction would be most welcome and beneficial to the gas industry, but also because we have our country's welfare at heart, and are profoundly conscious of the danger involved in a serious protraction of the present situation.

A Season of Clear Weather.

Up to the very end of the year—that is to say, yesterday—the character of the weather was unseasonably mild, and remarkably free from fog. London has never been so favoured with clear atmosphere at this time of the year within living memory. While the mildness of the air was a welcome boon to those householders to whom the dearness of fuel is a serious consideration, the absence of fog throughout all November and December was an additional blessing to the weak and ailing portion of the population of our great towns. Now that the year has turned, it may be hoped with confidence that the quickened air-currents that usually attend this season will keep fog away for the rest of the winter. In any event, the atmospheric brightness of the early winter is a fact to be thankful for. Many explanations have been offered to account for this unprecedented state of things aërial. It is in the main, of course, due to the wet and warmth of the air and sky. If there had been any frost worth mentioning, there must also have been fog in town.

There is yet another reason for this comparative clearness and cleanliness of town air, in the great extension among poor townspeople of the use of gas for cooking. London is a vast region covered for the most part with small, low houses. From many thousands of the chimneys belonging to these domiciles, clouds of low-temperature smoke used, in bygone years, to rise in the still autumnal morning air, and hang about all day. Morning pilgrims to the City by the suburban trains could smell the kindling wood smoke, and see it grow darker as the coal for cooking breakfasts became ignited in its turn. There is no smoke of so sluggish and clinging a nature as this breakfast-fire product. Coming from cold grates, up a cold chimney-flue, into a moisture-saturated atmosphere, it has no power of getting away; and before the morning fire burns clear, it is smothered again with kettle and frying-pan. Thus, the fires themselves are exceptionally smoky; and the smoke once emitted hangs about over the roofs. This is the surest possible prescription for making the once famous "London particular" fog. But now the ingredients no longer exist in such plenty. Though the Thames Valley mists remain, there is less smoke to aggravate matters in this regard. The prepayment gas-meter has made its mark in the working-class world; and the matutinal smoke-volcanoes of the town are fast becoming extinct.

A Last Word with the Petroleum Doctor.

It is not a very important matter, perhaps; but before leaving the question of gas-oil prices to solve itself with the efflux of time, it may be expedient to briefly notice the last protests of the excellent Dr. Dvorkovitz, in the "Petroleum "Review," against our recent comments on the general position of carburetted water gas and the raw materials for making it. He persists in misunderstanding us as meaning Solar oil, and nothing else, when making mention of gas-oil. How absurd this mistake is, should have occurred to Dr. Dvorkovitz at sight of any of his own references to Borneo oil, or the advertisements of any dealers in the commodities called "fuel-oil," "gas-oil," and so forth. Besides, he has stated himself that there is nothing like enough of the real Russian Solar distillate imported into the United Kingdom to keep all the registered carburetted water-gas plants going. They must use something else. If only one particular brand of mineral oil, and that limited in quantity, were available for this branch of gas manufacture, to what price would the demand force it? Dr. Dvorkovitz is also much put out at our playful suggestion that he fancies his own little oil-gas making apparatus of 1892 is above the Lowe type of plant. He points instead to our own records of the performance of the Young system of oil-gas manufacture, and demands to be informed whether or not by this system the candle power obtained per gallon of oil is not considerably larger than that secured by the Lowe type of apparatus.

The record stands, of course; but what Dr. Dvorkovitz seems to overlook is that for the gas manager the duty of an oil-gas plant, in candle power per gallon, is not everything. On the contrary, it is a very unimportant consideration, if it is to be conditional on a small output for the space occupied by the plant. He seems to be oblivious of the industrial merits of the Lowe type of gas manufacturing plant. He concludes his expostulation with the warning to the gas industry that, "if they will continue the supply of low candle "power gas, and charge a high price, a great many people "will very soon adopt the electric light or revert to petro-"leum." The advice is superfluous, inasmuch as it is in the interest of cheap gas, not of a high-priced article, that the gas engineers of Germany, as well as of England, are taking steps to rid themselves of all their obligations to cannel coal merchants, oil importers, and photometrical functionaries.

Trade Nomenclature.

One of the greatest concerns of the English nation for the coming century will be the reconstruction and improvement of the schools and other educational institutions of the country upon a sound, scientific, and liberal basis. We fully expect that the "Journal," in common with every other serious periodical publication, will in future contain much more matter of an educational cast than has hitherto been found to be appropriate reading for technicians; for the instruction and training of the young recruits of the gas industry will want a good deal of looking after, if the quality of future followers of the profession of gas engineering is to be kept up to the mark. For the moment, we are only concerned to uphold the claim of gas engineering in all its branches to be an occupation for gentlemen, and—to a reasonable degree—of scholars. Very recently we had occasion to protest against the intrusion of vulgar errors of nomenclature, of the kind unhappily familiar in the American, into the British technical terminology of gas-fitting, and accused our contemporary the "Ironmonger" of lending currency

to such barbarisms as the naming of a lantern for high-power incandescent gas-burners an "arc lamp." To this reproach we have lately received the very fair reply that it is impossible for a trade journal, in noticing a particular maker's goods, to decline to recognize the names by which that maker himself has chosen to call his articles, however incorrect those names may appear to be to the writer of the notice. "Consider," it is remarked, "for instance, the "number of things incorrectly brought into trade with the "prefix 'electric.' If we took upon ourselves the general "revision of trade names, we fear that our hands would "be even fuller than they are already." This is perfectly right and reasonable; and we are very glad that our contemporary is able, notwithstanding its tradesmanlike regard for customers' weaknesses, to go with us so far as to declare that "the increasing practice of misnaming is to be de-"plored; but its 'quackery' is generally so self-evident "that the habit must in the end recoil on its originators." All the more reason, one would think, for true business friends of these ignorant offenders to give them a helpful hint betimes. How can manufacturers who persist in naming gas-lanterns "arc lamps" expect to do business with gas managers possessed of a scrap of either learning or professional self-respect? Such a possible purchaser would be disposed to say that when he went into electric lighting he might want arc lamps; but meanwhile he would send his orders to people who knew the difference between an arc lamp and a gas-lantern.

This criticism of the nomenclature of articles of trade is not trifling. To "call a spade a spade" is one of the first rules for the correct expression of one's meaning; and whosoever neglects it, does so at his peril. From the wording of an Act of Parliament down to that of a simple order for goods to be delivered or something to be done, there is no escape from the paramount necessity for correct, clear, and adequate expression, if things are not to go wrong somehow. Yet how little does the importance of a sufficient knowledge of the meaning of words, and constant observance of the rule of using them correctly, appear to be realized by many so-called practical people! Take Americans, conventionally accredited with the possession of the most severely utilitarian ideas respecting the conduct of human affairs. With the exception of the most highly cultivated American men and women, whom one does not often encounter in professional and commercial circles, the people of this nationality seem to use words anyhow. This is judging, of course, from the ordinary run of professional papers, technical notices in books and periodicals, and the common sort of newspapers. Recently the "Engineering Record," in the course of a favourable notice of the work of some American engineer upon the construction of a simple formula for computing the flow of water in channels, remarked that "the book bears the evidence of hard work and painstaking "toil on every page, yet it is written with such disregard "of the accepted meaning of scientific words, and contains "so many passages difficult to understand, that its value "is tremendously handicapped for practical purposes." Yet the unhappy man may be a graduate of some "University." This is the question: If those who are to be entrusted with the use of the English language, with their other acquirements, are not properly grounded in it, so that they can neither understand it clearly nor express themselves in it intelligibly, what is the good of all the other accomplishments they possess?

Another Lesson of Bethesda.

As a lesson upon the "slimness" of the professional Trade Unionist leaders, the actual state of the Bethesda labour troubles may be commended to the attention of those amateurs of Trade Unions who may be disposed to see in these organizations a means of elevating the backward classes of British workpeople in the ranks of citizenship. We have already mentioned the attempts of an agent of the London "Daily News" to get a hand in the Bethesda game, which Lord Penrhyn and his representative (Mr. E. A. Young) were playing all through with their cards on the table. After some weeks, during which the Bethesda strikers were protesting their Olympian indifference to anything and everything that the management of the Bethesda quarries might do to keep the employment open, because there was plenty of work to be had elsewhere, it was almost surprising to learn that, through the good offices of the "Daily News," a meeting had taken place in London between Mr. Young and certain representatives of the quarrymen. Various and sundry would-be important personages wished it to be known that they were "on" in this scene; several officious Trade Unionists advertised their names in the bill; and, of course, the London newspaper gentleman posed as the author of the piece. Alas! it did not happen to be true. Lord Penrhyn has been compelled to snub the whole of these pretenders—well intentioned or otherwise—by asking "The Times" to make it known that no outsiders had anything to do with the conference. But this is not the whole story. It was agreed at the meeting that a ballot should be taken of the quarrymen (as the persons most closely interested) on the question whether or not they would individually accept the employers' terms for returning to work. It will scarcely be believed, except by those who have experience of the unbounded effrontery of Trade Union officials, that in sending out what were called the ballot-papers, these Bethesda Union officials required the voters to sign them with their names and permanent addresses! Of course, the instant this outrageous proceeding became known to him, Mr. Young repudiated the whole thing, and demanded the recall of the papers. As he truly said, if filled up and signed as directed, they would simply provide the Union with a black list. Such is Trade Union fairness and honesty as between man and man. If this is Democracy in action, then—like the socialistic hatred of the cause of England abroad—it seems to be more than a little irrational, to say the least of it.

WATER AFFAIRS.

Two Views of the London Water Question.

THE measure of relief which the advent of the Christmas season brought to the columns of "The Times," enabled the conductors of that paper to find room, in the issue for the 20th ult., for a letter from Sir Theodore Martin on the County Council's Water Bill. The opinions enunciated therein are specially worthy of consideration, not only on account of the professional standing of the writer, but also because he has never been engaged on behalf of the Water Companies. On the contrary, he has acted adversely to them, inasmuch as he was associated with the late Mr. E. J. Smith in the negotiations which took place with the Companies in connection with the Water Trust scheme proposed by Mr. (now Lord) Cross some twenty years ago. That scheme contemplated, it may be remembered, the purchase of the water undertakings at an agreed price; Mr. Cross not being desirous of running the risk of a compulsory purchase upon the usual arbitration terms. The Bill embodying it was opposed by the Corporation and the Metropolitan Board of Works, with the result that what Sir Theodore Martin now says would have been "an excellent bargain for the "community" was lost. Terms of agreement were settled which cannot possibly be again accepted; and they were rejected merely, as he states, to satisfy the ambition of one of the above-named bodies to be masters of the water supply and of the enormous patronage which it would place in their hands. This ambition has been inherited by their successors at Spring Gardens; and what has been its effect on the ratepayers of London? That they have had to pay for promoting no less than twenty-four unsuccessful Bills, and bear the very heavy expense which must have been incurred in the preparation of a scheme which is not only not required now, but will not be wanted for certainly the next forty years. The enormous amount spent on both sides in connection with these abortive measures is irrevocably gone; and it is useless to lament its loss. The question now is, as Sir Theodore well says: "Shall the money of the ratepayers "be still further dragged from their already too depleted "pockets to gratify the 'vaulting ambition' of a section "merely of the Council?" In the promotion of their Bill for next session in the face of the report of Lord Llandaff's Commission, he considers they have shown "an indomitable "spirit of fight, at the ratepayers' expense," which even their staunchest admirers must view with misgiving. He characterizes the Bill as "defiantly ignoring the conclu-"sions of the Commission," and as one which, judging from past experience, is foredoomed to failure. He lays special stress upon the fact (as shown by the report) that, in the event of purchase, the present revenues derived from the undertakings would be insufficient to meet the interest and sinking fund, and that the deficiency would have to be made up either by increased charges for water or out of the district

rates; and he thinks that, with the experience of the School Board before them, the ratepayers may well regard such a prospect with alarm. He urges that, in the interests of this long-suffering body, the Council's Water Bill should not be allowed to proceed.

Last Friday a long letter appeared from Mr. Shaw Lefevre in reply to Sir Theodore Martin. Of course, the writer of it champions the cause of the body of which he is a member, and repudiates the notion that, in desiring to possess the water supply they are actuated mainly by a desire to extend their patronage, which he considers ridiculous; while, as far as their opposition to Lord Cross's scheme is concerned, he thinks the effect was to enable the ratepayers to escape from a bargain which would have had disastrous financial consequences. However that may have been, it will be impossible for a purchase to take place in future at anything like the figure then agreed upon; the Companies' undertakings having increased considerably in value since it was arrived at. It is therefore useless to go back upon that bargain. The points now to be settled, assuming that the control of the water supply is to be taken from the Companies, are who are to be the purchasing authority and what is to be its constitution. The Royal Commission recommend a Water Board; and the Government have decided that they will support the proposal. Mr. Shaw Lefevre very naturally objects *in toto* to such a solution of the problem. He contends that the scheme propounded by the Commission is radically unsound and impossible, inasmuch as it is based on "distrust of municipal and representative institutions." Moreover, its adoption would, in his opinion, result in an additional charge to the ratepayers "to be measured by "millions." If Mr. Shaw Lefevre sees, in the proposed constitution of the Water Board, evidence of "distrust" of the authority at Spring Gardens, there may have been good reason for it. But, whether such reason existed or not, the County Council will have ample opportunity of making themselves heard against the scheme when it takes definite shape in the Government Bill. He, of course, pins his faith to the Council as the only possible purchasing body consistently with the interests of London, and urges that their scheme is the only one which holds the field and affords a possible solution of the Water Question. They have modified it, in deference to the objections of the Commission to the severance of the water supplies of the surrounding districts, by securing representation of those districts upon their proposed Water Committee, or by supplying them with water in bulk. This scheme will, in due course, come before Parliament as an alternative to that of the Government; and then the merits of each will be fully considered. If the latter will, as is asserted, entail an unnecessary burden to the extent of "millions," it will very soon be rejected in favour of a more economical one. In the meantime, there will be a dissolution and re-constitution of the Council; and it is just possible that at the forthcoming election the public may not show themselves so deeply impressed with the necessity of that body becoming the Water Authority for the Metropolis as are a section of the members at the present time. Furthermore, as the new President of the Local Government Board pointed out to the deputation which lately waited upon him, the new Borough Councils have to be heard on this question, which, after long delays, really seems approaching a solution. Two methods have already been referred to; and Sir Theodore Martin suggests a third—viz., to "leave the Water Companies as they are "—putting them under such regulations as will ensure the "fulfilment of their duty to the public." It cannot be justly said that London is badly served by them; and his advice is to "let well alone." It is worth consideration, although we doubt whether, in view of the expressed intention of the Government to propose a Water Trust, it will be deemed worthy of being followed.

The Generation of Power Gas.—Among the numerous articles which have lately appeared in the technical press on the subject of natural, blast-furnace, producer, and other gas, are several by Herr Johann Körting, of Hanover, which have been published in recent issues of the "Zeitschrift des Vereines Deutscher Ingenieure." Herr Körting emphasizes the fact that there is often confusion in speaking of various kinds of fuel gas, and that water gas is not unfrequently confounded with Dowson or other producer gas; and so he is careful to note the distinction in chemical composition as well as in the methods of making. He discusses the cost and efficiency of coal gas, and tabulates the various commercial combustible gases, giving their relative thermal values. We hope to notice the articles more fully in an early issue.

ESSAYS AND REVIEWS.

FOR THE NEW YEAR.

With the last number of the "Journal" for the Old Year, we gave a backward glance over the events and tendencies of the past twelve months, as seen from our special standpoint. It seems therefore only natural that, with the first issue for the New Year, we should offer a few observations upon the prospects which the year appears to bring with it. So far as the technique of gas manufacture is concerned, it is safer not to anticipate the particular lines which improvement may take, because that is a kind of exercise in prophecy which is rarely justified by events. Suffice it to remark that the industry of gas lighting starts a New Year and a New Century with a clue to greater possibilities as regards good and economical service—in the incandescent burner—than have yet been perceived, much less realized. When it is possible to say such a thing as this of any industry, it follows that any acceptable and sound view of the future must be of an optimistic character; and that is enough to prophesy.

So far as the other popular uses of gas are concerned, the prospects are not so open. Gas cooking apparatus has become standardized; and there is no novelty in the market to play for cooking gas the part of the Welsbach invention in the field of lighting. There is plenty of opening still for the commercial extension of the trade in gas cooking appliances, and in the supply of gas for them; but nothing fresh is required to help the gas-kitchener to a position of equal universality with the coal-range. It cannot be said that gas appliances in general for household use show any marked tendency to alter their *status* of being tenants' fixtures, and become an integral part of the houses of the people. Perhaps it is not desirable that this change should be made; but, however this may be, the fact remains that the extent of the domestic use of gas is a matter of the individual householders' taste. As a comparatively little, but still not unimportant matter, especially in the everyday life of small towns, it is greatly to be hoped that the method of the conventional "gas exhibition," as a means of pushing local trade in gas-stoves, may fall into disuse as it long has into disrepute. Cookery lectures are no novelty anywhere; being indeed a common form of popular instruction operations of County Councils and School Boards. Gas-cookers will always be popular aids to these demonstrations; and this reputation should be sufficient to secure a growing trade.

Gas heating-stoves, again, appear to have dropped into the "shop pattern" stage of existence as articles of trade, and to rest under the repute of being make-shifts. We do not see that they achieve any substantial progress in the affections of persons of refined taste in house furnishing. Neither are they poor men's "tackle," for obvious reasons. The consequence is that the gas-stove, or the gas-"fire," hangs, so to speak, between heaven and earth; not being acceptable for the drawing-room, nor possible for the cottage parlour. There is, of course, a large field for these articles in counting-houses, offices, shops, and dwelling-houses where æsthetic sensibilities are not powerful enough to prevail against the recommendation of their practical convenience; but one would fain see gas take a higher rank among the gains of modern civilization. This it will never do while the makers of this class of goods keep in the rut of imitation. They seem to be obsessed with the notion that it is imperatively necessary for a gas-"fire" to be a caricature of a coal-fire, when it is not in the shape of a crude substitute for the latter, designed to hang on the front-bars of the empty grate like a Dutch oven turned the wrong way about. It is almost needless to remark that this imitative character of the common run of gas-"fires" is fatal to any prospect of their being found pleasing in the eyes of a generation that has known Ruskin and Morris. A thing which has no character of its own is damned. How to overcome this radical objection to the complete acceptance of gas for house heating, is a very serious question.

The systematic adoption of gas as a household servant on the scale practised and recommended by the late Dr. Lawson Tait seems as far as ever from general realization. It would be well if those who, by calling, experience, or taste, are competent to throw light upon the reasons for this backwardness—with reference to other causes besides the imperfect nature of gas-"fires" already mentioned—could agree to hold a conference on the subject. We shrewdly suspect that the slowness of progress in this regard, as in so many others, is due in no small degree to patents, and the attractions for tradesmen of proprietary articles. Men in trade who know what is good for various requirements of the public, simply will not put such commodities or services at the disposal of the public, because there is no "speciality" in them. The long-suffering householder is asked to pay dearly for somebody's patented arrangement for doing by a roundabout device what might be effected much more simply and cheaply in another way. But it is nobody's business to do it in the cheapest and simplest way; and so the trade is checked. The tradesman's interest lies in having something to sell that cannot be bought of anybody else; consequently he dearly loves a patented article. Those things which are nobody's speciality are not on sale. Let a man who really knows what he wants, endeavour to light, warm, ventilate, or drain his house upon strictly scientific principles, and without depending upon any special fitments, and he will scarcely get a

tradesman to serve him. Of course, we are not speaking now of really important patented inventions, which have a vogue on their merits, but only of the petty trade patents which are mere excrescences of modern shop-keeping methods.

Of the future of gas power it is hardly possible to treat acceptably in the course of a general survey of the situation. It will take a good deal more invention than is at present in evidence anywhere to beat the gas-engine as a cheap and handy source of motive power for stationary uses, within the well-recognized limits of its utility, with ordinary gas. These limits lie, roughly speaking, between a lower unit of 5-horse power, and a higher limit of 50-horse power. Below the former line there exists a large, and at present almost untouched, field of usefulness for very small electro-motors. The driving of ventilating fans, and the working of an infinite variety of small shop and warehouse tools, are examples in point. For the higher power units, gas-engines of special design are already crowding into the market. It is worthy of notice that commercial gas-engines are already pretty strictly standardized. The idea of improving upon the "Otto" cycle seems to have been abandoned; the utmost that is attempted being the modification of the essential elements of the cycle with the intent to secure particular advantages. There is no such fresh "break" in internal combustion motor engineering as there is in steam power, with the turbine. Nor is there likely to be, upon similar lines; for the materials of a turbine could not stand at flame temperature.

Looking ahead thus, we can see sufficiently far into the future of the gas industry to perceive that the main lines of extension are open. As regards the one great and notable novelty—lighting by incandescence—it is impossible to predict what direct and consequential developments will be forthcoming in the fulness of time. With respect to the more hum-drum commercial prospects of other means of using gas, there is no fear of any falling off of the demand for gas or for the appliances for utilizing it. Is it possible to be satisfied with this expectation? Yes, if the mere payment of dividends, or the interest and redemption of capital loans, or the earning of salaries and wages, is alone in question. There is no appearance in this purview of any fresh danger to gas property, or of reversal of the usual order of things in respect of the due payment of the labourer's hire. It would be more satisfactory, however, if the New Year could stir with a little more life the dry bones of statutory gas undertakings' administration. Much has been done of late years to ameliorate the lot of the gas worker in other respects than merely raising his wages; but there is still a terrible "time-lag" in many places. The progress of the adoption of labour-saving mechanical appliances is slow and languid in British gas-works; but the advancement of the condition of the labourers remaining in the employment is slower still. Similarly, the standard of efficiency for the higher grades of the employment rises very slowly; while that of emolument in the responsible grades does not rise at all. Men who ought to do better, are content to receive less than they should be worth, and are not sufficiently anxious for their merit to shame their recompense.

There is a good deal of levelling-up to be done in all grades of the service of the gas industry, before any fresh advance in a particular quarter can do much good. Deeper, more thorough technical instruction; higher personal ideals; the cultivation of an insatiable thirst for knowledge; impatience of all second-hand and hearsay information, and of every realized inability to apply what seems to be known; a horror of falling into ruts—there is as much call for these watchwords of progress in the gas industry as there is in any other established calling. Nothing revolutionary is remotely desirable. Men can travel far enough along the old ways if they will only keep moving in the right direction.

THE COAL QUESTION IN 1900.

The coal question has been, throughout the whole of the past year, of such constant interest and vital importance to the gas industry, that it may not be an unprofitable business to review its different aspects, and summarize its history, in greater detail than it was possible to do in the course of our general survey of the events of 1900. There is felt, be it said, no sense of raking among the ashes of a dead past in carrying out this task; for the question is to-day as full of life as ever, and one to which the closest consideration must necessarily be given during the coming months.

The opening day of the year 1901, however, finds the gas manager in very different circumstances as regards his coal supply from those attending the early half of the year just closed. Few gas managers will easily forget their experiences in the first three or four months of 1900. At the commencement of the year, stocks of coal were sufficiently low at most gas-works to cause anxiety as to what might happen in the event of a prolonged spell of winter weather severe enough to block up the railway cuttings and seal the canals, while at the same time increasing the demand for gas. There can be no question that, had a winter been encountered a year ago similar to that of 1880-1, 1891-2, or 1894-5, not a few gas undertakings would have failed to carry out their obligations to their consumers. Managers had the unusual experience last winter of being in a position in which fog and frost were the most unwelcome of visitors. Fortunately, they were only in evidence intermittently, and never very aggressively.

The depleted condition of the coal-stores was all the more serious in that it was occasioned—especially as regards undertakings situated at a distance from the coal-fields—not by the neglect of the directorates to buy coal, but by the extreme difficulty experienced in obtaining delivery of what was bought, and the practical impossibility of making further purchases except of insignificant quantities at fancy prices. It was not a question of "At what price can we buy?" but of "Where can we get coal at any figure?"

This condition of affairs, in spite of an open spring, did not improve, but rather became more acute, as the weeks passed, until about the middle or end of April, when some of the biggest of the gas companies were absolutely without any stock, and were living from hand to mouth on the daily deliveries. Things then began to mend; and as, while gas consumption slackened down with the lengthening of the days and the rising of the thermometer, the deliveries of coal were maintained and steadily increased, stocks soon began to accumulate. So rapidly, indeed, did the position alter that, by the end of the June half year, the South Metropolitan Gas Company (who had only 41,000 tons of coal in their stores on Jan. 1, and very much less at a later date) showed in their balance-sheet a stock of 162,000 tons, or something like five maximum winter weeks' requirements. The Gaslight and Coke Company had also brought their stock up to a normal figure by the end of June.

In the meantime, however, and before the situation had shown any signs of easing off, contracts were being made for future supplies. The coalowners took full advantage of their position, and gas coal buyers, when obliged to go into the market—which many of them did rather earlier than usual—had to sign contracts at prices equal to about 16s. 6d. per ton f.o.b. for Durham gas coal, as compared with about 8s. 6d. in 1899, and 6s. 6d. in some former years. The railway companies, who bought in May, had to concede 5s. a ton or more to the collieries, in order to obtain contracts. Most undertakings, making absolute safety their first and sole consideration, swallowed the pill whole, and closed contracts for the usual period of twelve months, and for the total of their estimated requirements for that period. The South Metropolitan, among the gas undertakings, and the Midland, among the railway companies, were the most conspicuous instances of large consumers declining to commit themselves at once to paying top prices throughout the contract year. The one bought supplies for six months only, the other for four months. Unsupported by other industrial consumers, however, and in face of a market hardened by the panic purchases of house-coal buyers, they were unable to make any better terms later in the year; but the former of the two Companies at least will probably benefit considerably by the purchase of the balance of their requirements (Mr. Livesey rarely buys all he wants "on contract") in the market during the next month or so.

Not only, then, did the fact that coal was once more plentiful at the works, and was coming in freely from the contractors, afford welcome evidence of an easing of the situation by the end of June, but further grounds for a hopeful view of the future existed. The iron and steel trades—whose abnormal activity, extending over a period of some eighteen months, had been, together with the attendant general revival of trade, largely instrumental in bringing about the high price of coal—had begun by this time to show unmistakable signs of having passed the zenith of their prosperity. The dearness of all metal goods in this country produced the double result of checking the exports of those goods to other countries, and of attracting to our markets the lower-priced manufactures of our commercial rivals. The prospect of relief to the English consumer being afforded by the influence of American competition upon the prices of iron, steel, and machinery, was early recognized in the "Journal," and that influence had begun to make itself felt by the middle of the year.

Several factors in the situation, however, prevented an early fall in coal prices. There was, first of all, the continuance of increasingly large shipments of coal to other countries, as to which we shall have something more to say presently. Then there was the stupidity of the newspaper Press. Just as coal was on the eve of a moderation of prices, the papers, beautifully humbugged by the coal merchants, began to proclaim the probability of a coal famine during the then coming winter, and to urge those who had cellar-room and spare cash to buy while there was yet time. Their readers promptly rushed to the coal market, with the result that in July, August, and September the merchants were fully as busy delivering house coal as they usually are in mid-winter; and prices were raised at the beginning of August. So did the hack journalist crown his long succession of achievements in the direction of informing the public upon the coal question. Then he turned round and blamed the public for being in such a hurry to buy.

Finally, to help strengthen the market, there was the absence of any stocks of coal at the pits. These factors, together with the dispute on the Taff Vale Railway, the strike of coal miners in the United States, and a stoppage of output in the Cannock Chase district through trouble with the engine-men, helped to sustain the market until well on in the year; and the collieries have striven hard to keep up the appearance of being busily occupied by sending in full, and even excess, deliveries under their contracts. The result is that gas-works everywhere have unusually heavy stocks, and odd parcels of coal have of late gone begging, till sold at a heavy reduction in price. We have done our best to make these very significant facts known to all whom they concern in the gas world, in order that the true inwardness of the situation might be seen, and might be a guide as to the right line to take in regard to future purchases.

Most of the causes above mentioned as keeping up coal prices

until late in the year, have disappeared or are disappearing. The rush of the public to buy was over some three months ago, and the subsequent reaction was so marked that house coal has been a drug in the London market for some time past; and prices were actually lowered 2s. a ton by the Forest of Dean coalowners on Dec. 1, on which date also the Scotch collieries put the price of splint coal down 1s. The several labour troubles mentioned have been settled for the time being; and it is obvious that the collieries will not be able to continue indefinitely pouring coal into the stores of the gas companies at the rate they have been doing since midsummer. As, too, the depression in the iron trades becomes more and more marked (the year ends with a further drop in the price of bars), and the Continental demand for coal is likely to slacken somewhat, though not very materially at present, the year 1901 may well be said to open under auspices vastly more favourable to the gas industry in regard to the coal supply than those which marked the advent of 1900.

The condition of the coal market last year, which we have been endeavouring to outline, naturally gave rise to much discussion, both as to causes and as to possible remedies—discussions that have been fully noted and commented upon in these columns. Numerous causes were assigned for the scarcity and very high price of coal. Our friend the ha'penny newspaper man was well to the fore, and well wide of the mark, with his reasons. His favourite one was that the coal famine predicted by Jevons had arrived. Upon this point, all readers of the "JOURNAL" were in possession of the full facts before the coal shortage had been discovered by a Press pre-occupied with South African affairs. The articles published in our pages during last February showed, as conclusively as possible, that the scarcity of coal in the market was no more due to the exhaustion or even serious diminution of the nation's stock of coal, than it was to sunspots. The shortage was, in fact, only of available coal, not of existing coal. Then the War was said to have caused the scarcity, the outbreak of the one synchronizing with the discovery of the other; but the influence of the hostilities in South Africa upon the coal supply was by no means a serious matter. Again, it was the Railway Companies, or a Coal Trust, or the lazy coal miners that had brought about the trouble. But none of these suggestions bore examination; and the real causes of the difficulty were seen to be not obscure, but obvious. The plain fact of the matter was that the output of coal had increased, but not in so great a ratio as the consumption. Stocks were being steadily used up, until the day came when the demand obviously exceeded the supply; and then, coal being an absolute necessity to the majority of its users, everyone rushed to secure his requirements, and was willing to pay any price rather than fail to obtain them.

This expansion of consumption at a more rapid pace than the growth of the output had, moreover, been going on all over the Continent of Europe, as well as in this country. Industrial activity was very great in France, Germany, and Russia, and their coal requirements expanded rapidly; the prolonged strike of the Austrian miners seriously aggravated the situation; and, England being the great coal supplying nation, the Continental consumers placed constantly increasing orders in our market, no matter what price they had to give. The exports of coal from this country have accordingly gone up by leaps and bounds, more especially in value, but also very materially in quantity. The following comparison will make this point clear:—

Year.	Coal, &c., Exported to Foreign Countries. Tons.	Value. £	Bunker Coals Shipped. Tons.	Total. Shipments. Tons.
1897. . . .	37,672,706 ..	17,040,940 ..	10,455,758 ..	48,128,464
1898. . . .	37,002,495 ..	18,541,551 ..	11,264,204 ..	48,266,699
1899. . . .	43,583,223 ..	23,544,562 ..	12,226,801 ..	55,810,024
1900(estimated)	46,500,000 ..	39,000,000 ..	11,500,000 ..	58,000,000

The exportation of some 25 per cent. of the total output at a time when coal was so urgently needed in the home market—serving, as it did, to stiffen prices to the home consumer—led to demands being made from many quarters for the imposition for coal exports of a duty designed to restrict or altogether to prevent such exports. Those demands were met, by correspondents of the "JOURNAL," with arguments showing that such a policy would have disastrous effects upon the trade of the country, and would not in the long run achieve the purpose for which it was adopted; the truth being that the prosperity of the nation would be seriously crippled at present, with the sole beneficial result of conferring a hypothetical benefit upon posterity a century or two hence. The sensation-mongering Press sought to put a sinister construction upon the large importations of coal into France; imputing to our neighbours the design of denuding our market of steam coal, with a view to using the same against us in a war that was to be declared last November. We showed then, and time has proved, that no such construction was justified; and it is to be regretted that newspapers are to be found in this country capable of publishing such mischievous and untruthful statements simply for the sake of calling attention to themselves.

The serious effects of the high price of coal, and the alarm occasioned in some minds by the growth of the exports, together with the doubts existing as to the probable duration of the nation's supply, and especially of the steam coal essential to the efficiency of our navy, resulted, during the summer, in a spasmodic and not very well organized agitation for the appointment of a Royal Commission to inquire into, and report upon, the various aspects of the subject that is comprehensively spoken of as The Coal Question. This demand, which the Government did not deem sufficiently urgent to satisfy, was supported in these columns on the grounds that, while the report of the Argyll Commission of 1871 embodied a large mass of information, the statistics therein contained require to be brought down to date, and the estimates revised in the light of subsequent knowledge; and further, that an official pronouncement upon some questions not dealt with in that report—such as that of the requirements of our navy, and of the possibility of supplies of American coal reducing the drain upon our mines by foreign buyers—would be welcome both to the general public and to large coal consumers, like the gas industry. We hope the request for the appointment of a Commission—or, what would probably suffice, of a Home Office Committee of Experts—will be renewed, and be successful, in the coming session of Parliament.

The possibility of relief to the English market being afforded by the competition of American coal in the foreign markets hitherto supplied from this country, and even of the importation of considerable quantities of coal into England from the States, was widely discussed a few months ago; and no little interest was displayed by the public in the arrival last August in the Thames of a cargo of Philadelphian coal consigned to the South Metropolitan Gas Company. This, however, has been practically the only parcel of American coal delivered in England; and there can be no question of any quantity being imported from the States in the future, except in very abnormal circumstances. The question of foreign markets being supplied from that source is a very different matter. Large shipments of United States coal have already been made to Europe—amounting in the first ten months of 1900 to 540,000 tons, as against only 19,000 tons in the corresponding period of 1899; and increasing quantities are being imported by the South American countries from the States, instead of from England. Every ton so delivered tends to the easing of the pressure upon the English market, and the Yankees are sparing no effort to increase their foreign coal trade. It must, however, be some time before the needful tonnage can be found; and the freight difficulty is a serious one to a country with a high protective tariff.

The exigencies of space demand that we should bring to a close this imperfect review of the varied aspects of this all-important question which have presented themselves for consideration during the past year. Everything points to there being a very different history to recount when looking back, in twelve months' time, upon the events of 1901. The one consideration that forbids an exclusively optimistic forecast of coming events, is the fact that coal miners' wages are now very high, and must come down considerably before next Christmas; and we anticipate (wrongly let us hope) considerable resultant friction.

MERCHANTS' VIEWS OF LAST YEAR'S TRADE.

WE have received from Messrs. Bolling and Lowe, the well-known firm of merchants, a copy of their annual review of the iron, steel, and kindred trades, upon which we base the following notes. The outstanding feature of the twelve months is, of course, the abnormal activity and prosperity that characterized the iron trades during the earlier half of the year, and the coal trade throughout. The makers of finished iron and steel goods were very full of orders, both home and export, when the year opened, and continued to register fresh contracts faster than they could clear off arrears during the first three or four months. The climax was then reached, and business gradually eased off until buyers realized that the tide was on the turn, with the result that during the last few months fresh business has been difficult to obtain, and a general weakening of prices has commenced. Manufacturers will, however, have to make further concessions before buyers will again come freely into the market, as prices are still very materially higher than in normal times.

In regard to the tinplate trade, it is remarked that "there is little to say now that the American market is practically closed to us, except that we may shortly find American manufacturers competing in this trade, as in others." As to shipbuilding, this is stated to have been on not quite such an extensive scale as in 1899; buyers, confident of reduced prices in the near future, and unwilling to permanently handicap themselves by laying out fresh capital on ships at top prices, holding back their orders. It is worthy of note that prices of steamers are to-day 35 per cent. above those in 1897; while at the beginning of 1900 they were as much as 50 per cent. higher. The locomotive and rolling-stock manufacturing branch of the engineering trade is at the present time the best employed; most makers having orders on hand that will take a long time to execute.

One of the interesting features of the present situation is the comparative smallness of warrant stocks. The existing stock of pig iron in Connal's stores (Glasgow) is lower than it has been for twenty years; being under 80,000 tons, whereas in the year 1887 the record stock of 943,000 tons was held. It is suggested that the tendency for the future will be to keep lower stocks than formerly, rather than lock up so much capital; but it is doubtful whether makers will not find it more profitable to put iron into stock than let their works lie idle when orders are scarce.

On the question of the coal supply, Messrs. Bolling and Lowe remark:

> Last year's [1899] output, 220,085,000 tons, is expected to be exceeded, and [that for 1900] to approximate 230,000,000 tons, in spite of enhanced

prices. Of this quantity, about 60 million tons have been exported, and the remainder (170 million tons) consumed at home by industrial concerns, railways, gas-works, &c. In consequence of the advanced cost of fuel, makers of finished materials have naturally raised their prices; and the foreign consumer has doubtless paid for the increased value of about 100 million tons of coal, say, £25,000,000. The tonnage is made up approximately of 60 million tons shipped as above, and 40 million tons represented in the working-up of material for export.

Every additional advance of 1d. per ton on the price of coal means, on the total output, about £1,000,000 extra profit. Wages in the South Wales [and other] collieries are now higher than they have ever been. Owing to the high price of coal, great impetus has been given to the employment of liquid fuel, which is found principally in Russia, the United States, and the East. It will doubtless be more extensively used in the future. It was officially announced in St. Petersburg on the 25th of October that the Minister of Ways of Communication had decided to use naphtha on all locomotives running on the Russian railway system.

Reference is made to the perennial grievance of railway rates "carriage on all material being excessive, when compared with what our foreign competitors pay." The only observation to be made upon this point is that the railway companies do not pay by any means extravagant dividends; and it not easy to see how relief is to be given in the matter of goods rates except at the expense of the passenger—unless, of course, it can be shown that lower rates would mean a greater volume of business. Can it? If so, the sooner Parliament and the Companies are convinced of the fact the better.

One of the main factors in the great revival of trade that has been witnessed during the past two or three years has been the industrial expansion of the United States, which have now enjoyed several years of unbounded prosperity. Large crops of cereals, and moderate crops of cotton, with liberal prices for both, have together enabled the States to develop numerous local enterprises, and have led to a great extension of the railways of the country. The length of railway completed by the end of 1899 was 190,833 miles, as against 93,262 miles in 1880; and it is estimated that, by the close of 1901, the figure will reach 200,000 miles. The weight of rails required for the extensions in 1900 and 1901 together is computed at 5 million tons. This enormous quantity can, however, be easily turned out in the States mills, and more also, as rails figure largely in their exports; some even being imported into this country. Our own exports of rails have dwindled to a comparatively insignificant figure, and will not much exceed 350,000 tons for the year, as against about 750,000 tons annually in 1887-90.

In Germany, the success of companies connected with iron, steel, and engineering (not a few of them laid out on a much larger scale than our own) has been as marked as in Great Britain. They have written off very large sums for depreciation, and have added greatly to their bonus and pension funds, in addition to declaring excellent dividends.

The Money Market has remained firm during 1900; and although the tide of high prices for all kinds of goods seems to be on the turn, there is no immediate prospect of cheap money, in face of the heavy and continuous expenditure on the army and navy. The average Bank rate for the year has been only a small fraction under 4 per cent.—a state of affairs by no means welcome to the gas industry.

In conclusion, Messrs. Bolling and Lowe say:

There is no doubt that the iron, steel, and coal trades have had a record year. As in most cases handsome profits have been made, both by individuals and limited companies, we cannot conclude our report without expressing the hope that this prosperous condition will result in an ample sum being set aside for renewal and depreciation of plant and leases, &c., which accounts often have to suffer when the financial result of a year's working has not been satisfactory. We trust that manufacturers will seize the opportunity to bring their works up to date as regards labour-saving appliances, as this is the only way by which they can expect to compete successfully with our foreign rivals. We think the prospects of trade in the coming year will be moderate in comparison with this, and reduced as regards values The latter condition, however, may create fresh demand.

THE GAS AND WATER STOCK MARKET.

Last week—the closing week of the century—was an entirely uneventful one on the Stock Exchange so far as Gas and Water securities were concerned. In other and more speculative lines there was a terrible collapse, which it does not belong to us to narrate. Such was the quiet in our own department that there was no change of quotation in either Gas or Water Stocks, save the few which proceeded from *ex div.* adjustments. The Money Market stiffened considerably, and the demand was very strong. Happily, the Bank of England made no change of rate on Thursday; and so the hope we expressed, that the 4 per cent. rate (fixed on the 19th of July) might continue to the end of the year, has been realized.

It is of more interest to turn to the table which follows, showing the rise and fall in prices since the year began. The rises are very few and slight, while the falls are very considerable. The cause of this must be too vividly impressed upon the memory of all our readers to need demonstration, for the crushing impost levied on the Gas Companies by the coal factors last spring which knocked the prices of Gas Stocks all to pieces is not yet forgotten, nor is it likely to be for some time. Happily, the pendulum is now swinging fast the other way; and all appearances point to coal contracts for the New Year being arranged at a very large reduction from the figures of last year.

Name.	Prices on Dec. 30, 1899.	Prices on Dec. 29, 1900.	Gain or Loss.
GAS COMPANIES.			
Alliance and Dublin Company, 10 per cent.	21—22	19—20	−2
Do. 7 per cent.	14½—15½	13—14	−1½
Australian (Sydney) 5 per cent. Debentures	102—104	101—103	−1
Bombay, Limited	5⅞—6⅛	6—6⅛	+⅛
Do. New, £4 paid	4—4⅛	4—4⅛	—
Brentford, Consolidated	273—278	255—260	−18
Do. New	210—215	183—188	−27
Do. 5 per cent. Preference	140—145	137—142	−3
Do. 4 per cent. Debenture Stock	124—128	115—118	−9½
Brighton and Hove, Original	250—260	220—230	−30
Do. A Ordinary Stock	183—188	150—160	−30½
Bristol, 5 per cent. max.	130—135	122—124	−9½
British	43½—44½	39—41	−4
Bromley, Ordinary 10 per cent.	25—27	24—26	−1
Do. 7 per cent.	19—21	19—21	—
Buenos Ayres (New), Limited	8½—9	8¼—8⅜	−⅛
Do. 4 per cent. Debenture	98—100	95—98	−2½
Cagliari, Limited	28—29	23—25	−4½
Cape Town and District, Limited	13½—14½	13½—14½	—
Do. 6 per cent. 1st Mort.	56—58	53—55	−3
Commercial, Old Stock	305—310	275—280	−30
Do. New do.	240—245	207—212	−33
Do. 4½ per cent. Debenture Stock	140—145	132—137	−8
Continental Union, Limited	177—181	165—170	−11½
Do. 7 per cent. Preference.	178—183	165—170	−13
Crystal Palace Ordinary 5 per cent. Stock.	130—135	117—122	−13
Do. 5 per cent. Preference	140—145	130—135	−10
European, Limited	21—22	18½—19½	−2½
Do. £7 10s. paid	15½—16½	13½—14½	−2
Gaslight and Coke, 4 per cent. Ordinary	104—106	95—97	−9
Do. 3½ per cent. maximum	97—99	92—94	−5
Do. 4 per cent Con. Pref.	119—122	115—118	−4
Do. 3 per cent. Con. Deb.	96—98	94—96	−2
Hong Kong and China, Limited	13½—14½	13—14	−½
Imperial Continental	212—217	203—208	−9
Do. 3½ per cent. Deb. Stk.	101—104	100—102	−1½
Malta and Mediterranean, Limited	5—5⅜	4⅞—5¼	−⅛
Metropolitan of Melbourne, 5 p. c. Deb.	110—114	105—108	−5½
Do. Do. 4½ p. c. Deb.	107—109	104—106	−3
Monte Video, Limited	11—12	9½—10½	−1½
Newcastle and Gateshead, Consolidated	220—225	214—216	−7½
Do. 3½ p. c. Deb. Stk.	104—107	103—104	−2
Oriental, Limited	7—7⅛	7—7⅛	—
Do. New, £4 10s. paid	6½—6⅝	5⅝—6⅛	−⅛
Do. do. 1879, £1 paid	1⅝—1¾	1⅝—1¾	—
Ottoman, Limited	5⅛—5⅜	5—5⅛	−⅛
River Plate, Ordinary	10⅝—11	10—10⅛	−⅞
Do. 4 per cent. Deb. Stock.	98—100	98—100	—
San Paulo, Limited	12—13	11—12	−1
Sheffield, A.	247—249	232—236	−14
Do. B.	247—249	232—236	−14
Do. C.	247—249	232—234	−15
South Metropolitan, 4 per cent., Ordinary	133—136	130—135	−2½
Do. 3 per cent., Deb. Stk.	101—103	95—98	−5½
Southampton, Ordinary	—	107—112	—
Do. 4 per cent. Debentures	—	117—122	—
Tottenham and Edmonton, A.	141—143	112—117	−27½
Do. B	102—104	85—90	−10½
Do. 4 per cent. Deb.	113—117	110—115	−2½
Tuscan, Limited	9—10	7—8	−2
Do. 5 per cent. Deb. Red.	98—100	98—102	+1
WATER COMPANIES.			
Chelsea, Ordinary	305—310	305—308	−1
Do. 5 per cent. Preference	157—162	155—160	−2
Do. 4½ per cent. Preference Stock, 1875	140—145	142—145	+1
Do. 4½ per cent. Debenture Stock	148—153	143—148	−4
East London, Ordinary	200—205	193—198	−7
Do. 4½ per cent. Deb. Stock	145—150	147—152	+2
Do. 3 per cent. Deb. Stock	98—100	98—100	—
Grand Junction 10 per cent. maximum	107—109	109—112	+2½
Do. 4 per cent. Deb. Stock.	131—136	130—135	−1
Kent	348—353	303—308	−45
Do. New, 7 per cent. maximum	209—210	209—210	—
Lambeth, 10 per cent. maximum	290—295	293—298	+3
Do. 7½ per cent. maximum	215—220	208—213	−7
Do. 4 per cent. Debenture Stock	135—138	127—130	−8
New River, New Shares	428—433	415—420	−13
Do. 4 per cent. Debenture Stock.	133—138	128—133	−5
Southwark and Vauxhall, Ordinary.	203—208	192—197	−11
Do. Do. 7½ per cent. do.	190—195	185—190	−5
Do. Do. 5 per cent. Pref.	160—165	155—160	−5
Do. Do. 4 p. c. A Deb. Stk.	131—136	128—133	−3
West Middlesex	290—295	280—290	−7½
Do. 4½ per cent. Deb. Stock	147—153	140—145	−7⅞
Do. 3 per cent. Deb. Stock	100—102	98—100	−2

It has been claimed by Mr. A. T. Stewart, in an article on the domestic uses of electricity, published in "Chambers's Journal," that electric ovens, while roasting and baking to perfection, possess many advantages impossible with other ovens. The greatest of these, it is stated, is that the food is cooked in a pure atmosphere, with no smoke, smell, or dust, thus doing away with the necessity for a flue. Such an oven can be raised to a temperature of 400° Fahr. in about twenty minutes, after which some of the current can be turned off, and the food be allowed to soak in a gentler heat. The oven works on the same principle as the ordinary baker's oven, which, after having been once heated, has to yield up the retained heat. Mr. Stewart claims, therefore, that "very little heat is lost in radiation, and the whole of the heat is utilized in the interior of the oven. The amount of electricity required to heat it in the first instance may be twice as much as gas or coal, yet the cost in maintaining the heat is only half." It is remarkable that no precise information relating to the consumption of electricity in the working of an oven exists for comparison with the well-known data relating to gas roasting or baking, which is notoriously one of the most economical of all the domestic uses of coal gas. How the air of a perfectly closed oven, with food cooking in it, can be qualified as pure, is a question of the meaning of words. Some little ventilation of ovens has usually been segarded as desirable; but electricians appear to pride themrelves on dispensing with it, whether for lighted rooms or culinary apparatus.

ELECTRIC LIGHTING MEMORANDA.

Stray Currents from Electric Railways—The Case of the Underground Lines—The Tragedy of the Kew Observatory—The Remedy.

THE subject of the wandering currents which do, or may, escape from electric tramways or underground railways, is one that will bulk very largely in the periodical literature of the year that has just begun. It will be almost more than can be reasonably hoped for if, when the year draws to its close, any substantial progress can be recorded in the reconciliation of the opposing views of those who are diversely interested in the matter. We recently mentioned a somewhat alarmist statement of a part of the case, appearing in "Nature" (and therefore presumably emanating from some Panjandrum of the scientific world), but, of course, without adopting the writer's opinions, which were decidedly fantastic. He took as his datum an estimate of the amount of electricity actually passing at certain parts of the Central London Electric Railway system, and computed the weight of metallic iron that would be removed from the gas and water mains of the vicinity, supposing a certain proportion of this current to escape from the return conductors. This sounded very terrible. The tale, however, suffered from the weakness that there was no evidence—first, of the escape of current from the safe paths provided for it by the electric railway; and, secondly, that if current did escape from an iron-cased tunnel 60 feet or thereabouts beneath the existing gas and water pipes, it would necessarily attack them through intervening strata of clay and gravel.

As a matter of probability, about which it is unsafe to dogmatize, it is difficult to understand how electricity escaping from the conductors inside a Greathead tunnel could get away from the continuous iron casing which forms part of the structure. There remains the consideration of the possible leaks from transformer chambers, and also of the electric plant brought up to the surface at the stations. But this must be a trifling matter. On the face of it, and accepting electric traction as bound to come, by hook or by crook, it has always been our view that this had far better be in the form of the deep underground tunnel than otherwise. All experience hitherto goes to bear out this judgment. Unfortunately, there are not many localities where the amount of traffic is sufficient to support an underground electric tramway, with its heavy proportion of immobilized capital. Even the existing London lines of the kind are not exempt from the trouble of irregular loading, which is the worst affliction of suburban transport arrangements of all kinds. If business were always as brisk on these lines as it is during certain hours of the morning and evening, they would pay well; but even Londoners do not travel about town much in the middle of the day. And for whatever purpose electricity is used, the absence of reserve power remains the chief drawback of this form of energy. The load-factor is always the electrician's source of anxiety, after everything else has been satisfactorily dealt with.

Last week there appeared a long communication in "The Times," on the subject of the obstacles which prevent the London United Tramways Company from starting their new electric tram service between Shepherd's Bush and Brentford. This is another aspect of the question of stray currents; and the difficulty in the case is the Magnetic Observatory at Kew. The system of traction arranged for is the usual overhead trolley wire, with copper-bonded metals forming the return part of the circuit. It is candidly admitted that if this traction system were to be put to work, the effects would be felt at Kew, less than two miles away, by reason of the practical impossibility of keeping the return current to the path provided for it. This would mean the destruction of the Magnetic Observatory, and the spoiling of its many years of labour in the interest of pure science. Very naturally, those who are responsible for the work of the Observatory regard it as a hardship that this national institution should be sacrificed merely because an electric tramway is brought into the neighbourhood. We recorded at the time the proceedings at the Conference held at the Board of Trade in October, with the object of finding a way out of the difficulty, which ended in the usual manner with a request that the Department should discover a middle course which neither of the opposing interests was able to indicate. Two months have elapsed since this meeting; and the Board of Trade have made no sign.

Meanwhile, there is the tramway "held up" and idle; and "The Times" correspondent is girding bitterly at the Board of Trade for delaying the promised action. But the worst of the situation is that it is a real tragedy, inasmuch as both the irreconcileable opponents are right, and any possible decision must entail the sacrifice of one right to another. What is true of Kew is equally true of Greenwich, which also has a Magnetic Observatory. If the outskirts of London, in these different regions, are to be served with electric tramways, the Magnetic Observatories must go; and whither? Professor Rucker has come to the defence of Kew with the assertion that the delay of which complaint is made is due to the shortcoming of the tramway engineers themselves, who have failed to carry out their own suggestions for protecting the Observatory. If no adequate protection is possible, in the judgment of the capable advisers of the Board of Trade who have the matter in hand, then the more delicate part of the magnetic work of the Observatory will have to be removed to some place where electric tramways and railways are not likely to go. Such places will be harder to find every year. In any case, however, it is reasonably suggested that the cost of removal and the additional expense of maintaining a remote observatory ought to be defrayed by the commercial interest which renders this step necessary. That is how the business will probably be settled in the long run.

EXPANDED METAL AND COKE-BREEZE CONCRETE CONSTRUCTION.

ONE of the most valuable additions of recent years to the resources of the constructing engineer is "Expanded Metal," some interesting applications of which in gas-works construction were mentioned at last year's meeting of the Institution of Gas Engineers. It is often said, with considerable truth, that British engineers take but slowly to novel materials of construction; and there is much ground for the hesitancy of men who are responsible for the soundness of works to venture upon strange devices untried by Time. Time-tests are essential for establishing the merits of any method of construction which is intended to last; and while this experience is gathering, works in progress have to be carried on apparently regardless of what is new. All things come at last, however, to those who know how to wait; and at the present day expanded metal and concrete construction is a great fact of which engineers who have no wish to rank as fogeys must take due account. Writing with all respect for the possibilities of an unknown future, it truly appears as if the long tentatives in the direction of creating a universal system of reinforced concrete construction, which engineering critics have watched with mixed feelings, had at last attained the desired end with the adoption of expanded metal for this purpose.

It has been the practice of the "JOURNAL" to follow the varied fortunes of the Monier and other proprietary systems of reinforced concrete construction; as to which it can safely be remarked that, while they succeeded in demonstrating experimentally the soundness of the principle involved, they did not carry all before them as practical expedients. So much was made to depend upon the proper "installation" of the reinforcing metal, and this usually required such careful and intelligent supervision, that much of the economy of the systems was lost in the process of attempted realization. With expanded metal, however, used as described at the Institution meeting, all this delicacy and the resultant uncertainty disappears. Expanded metal concrete construction is not a proprietary article. The system of using it for this purpose is open to all the world, which is an enormous advantage. Consequently, all the other provisional and proprietary systems are superseded. The reason for this is, of course, that the profit is made on the peculiar commercial article of expanded metal itself; and when once this is purchased, the buyer can make whatever use of it he pleases.

It has occurred to us that possibly readers of the "JOURNAL" might like to know something more about the genesis and history of this remarkable commercial product. It is interesting, to begin with, as an excellent illustration of an object of invention which has proved far more useful in other ways not contemplated by the inventor, than for the applications which he had in mind when he first conceived the idea. As the story is told in the "Journal of the Franklin Institute" by Mr. James S. Merritt, when Mr. John F. Golding, of Chicago, first attempted to make what is called expanded metal, he thought it would prove useful as a material for making into fences, window guards, and so forth; and he called it "slashed metallic screening." As matters have developed, probably not 1 per cent. of the output of expanded metal at the present day is used for such purposes, the greater part of it being employed for reinforcing concrete structures. On the face of it, therefore, the expectations of the inventor were disappointed; and in a sense his invention was a failure. But there were other possibilities for the new form of iron network which soon showed themselves; and Mr. Golding was happily able to seize the opportunity and adapt his speciality to its real field of usefulness.

Here again, we have a good illustration of the difference between the crude, popular notion of what constitutes an act of invention, and the reality. To have merely conceived the idea of piercing and stretching out sheet metal until it had the general appearance, and was capable of fulfilling the office of, wire netting—which would appear to constitute the "invention" in popular estimation—would have availed nothing at all. The inventor in this case went further, and schemed the machine for making his new-fashioned metallic screens. This completed the invention, so far as the original idea went; but it did not go far enough. The original slashing and spreading presses worked on the sheets of metal fed into them diagonally. The first descent of the knives cut one slash, in the corner of the sheet, and pushed the edging down at right angles to the rest of the sheet. The next stroke cut three slashes, pushing the edging down in the same way; the following cut made five slashes; and so on. Thus the width of the sheet metal that could be cut in this way was limited to the housings of the machine; and as the sheet was fed in diagonally, it was usual to limit the dimensions of the expanded sheet to 8 feet by 4 feet. The thickness of the metal was also limited. One effect of this method of manufacture was that the expanded sheets were never quite square. The material was of little or no value to engineers; while as fencing it did not take well.

Not to be defeated, in 1894 Mr. Golding improved the method of, and the machine for cutting, the sheet metal, which made all

the difference. Now the sheet metal is cut, and the mesh formed partly by bodily stretching the connecting edging; the elongation being over 10 per cent., which requires the use of the right kind of steel. This makes exactly square sheets, of a width only limited by that of the original sheet of steel, or by the possibilities of handling the expanded sheet which drops down vertically behind the shears. The sheets are, of course, treated to all the necessary annealing and pickling in the process of manufacture. The destination of these expanded sheets for reinforcing concrete slabs, renders it an important question whether the process of cutting and mesh-forming causes incipient cracks in the steel which would seriously reduce its tensile strength in the various directions taken by the edgings of the holes. An elaborate series of tests carried out in 1897 by the Massachusetts Institute of Technology, shows that such is not the case. This result is greatly due to the care which is taken in the selection of the stock and its treatment; and also to the fact that the shear blades are kept in a much better condition and more accurately adjusted than is usually the case with metal-shearing machines.

Thus it will be seen from this brief history of expanded metal that there is nothing in it to lend colour to the popular delusion, fostered by touting patent agents, that a profitable invention is of the nature of a happy "hit," made without previous knowledge, trouble, or forethought. The idea is, of course, the starting-point; but the motive-power which drives the invention along the up-hill road to an eventual and perhaps deferred success in application is an essential element of general result.

It so happened that at the epoch when Mr. Golding perfected his invention, engineers and architects were on the look-out for something strong, simple, cheap, and trustworthy in the shape of a reinforcement to save economical concrete construction from the discredit that seemed to impend over it. Heavy concrete, composed of solid broken stone of considerable density, with sharp sand and cement, had been supplemented for particular uses with another and radically different description of concrete, the characteristic of which was lightness. This light concrete was composed of gas-works "breeze," or of furnace clinkers, and cement. It differed in many other respects than specific gravity from the heavy, engineer's concrete primarily designed to compose strong monolithic structures. It was meant to make roofing flats, and landings, in ordinary buildings; and nails could be driven into it. In clay countries, concrete composed of burnt ballast and cement occupied a middle place between the heavy stone and the light breeze cement concrete.

Up to a certain period, all concrete constructions were expected to stand alone—that is to say, without metallic reinforcement. This requirement necessitated great thickness and heaviness in the concrete structure; and not unfrequently there were terrible breakdowns, for no apparent reason. The difficulty was to ensure against these sudden "solutions of continuity," due perhaps to some innate untrustworthiness of the material as usually made, or to almost unavoidable carelessness of workmanship in its preparation. If no way out of the difficulty had been discovered, concrete building would have fallen into disrepute, which would have been a calamity. Happily, the expedient of metallic reinforcement came in the nick of time to save the concrete situation. It could not bring complete immunity from collapse due to overloading; but it could, and did, lighten the construction very materially, and convert collapses from sudden catastrophes into failures after warnings. The handiest of all reinforcements is expanded metal.

The avidity with which "up to date" building constructors have seized upon this addition to their resources is sufficiently shown by the circumstance that 200 acres of it, of different scantlings, were used in the buildings of the Paris Exhibition of last year. Yet again, it only arrived at its engineering destination, as a reinforcement for concrete in mass, after approving itself as the best support for plaster. It not only substituted wood lathing for this application, but was found to be a decided improvement upon it. On a basis of expanded metal, partitions between living rooms can be made 1½ or 2 inches thick, which is a valuable consideration where space is limited. These solid partitions are proof against sound in a remarkable degree. As there is nothing in them to shrink, like wood, the plaster does not crack. The first application of expanded metal to reinforce concrete slabs is ascribed to Mr. Golding, about 1892; and the success of the experiment was complete. As Mr. Baker has testified, by reason of its peculiar construction, sheets of expanded metal laid upon a flat surface, such as the supporting planks for a concrete slab, only touch the latter at certain points; and consequently it is not necessary to offset a sheet of the expanded metal before laying the concrete over it.

Cinders, clinkers, or breeze with cement, which ought not to be too quick-setting, make a concrete which, when reinforced, will withstand a tremendous amount of heat. This is not to be wondered at when it is remembered that cement itself is a clinker, and that all these agglomerates have passed through the fire also. The use of reinforced concrete construction has been adopted by Mr. James Mansergh for the conduits of the Welsh water supply scheme of the Birmingham Corporation; and it is indicated as particularly suitable for underground conduits and sewers in which the fluid contents are likely to exert at times a bursting strain on the sides and covering. The occasions must be many in gas-works construction when this system of construction, with one of the components arising on the spot, will commend itself as answering all requirements; and it will probably take a large part in town building operations of the immediate future.

PERSONAL.

Mr. H. Yuill has been appointed Secretary to the Cape Town and District Gas Company.

Mr. John Aird, M.P., has been created a Baronet; and an intimation to that effect appears in the New Year's list of honours.

Mr. Charles E. Botley, M.Inst.C.E., Engineer and Manager of the Hastings and St. Leonards Gas Company, has been elected a member of the New Technical Instruction Committee of the Corporation.

After 35 years' service, Mr. T. Wardle has resigned the office of Secretary to the Kidsgrove Gas Company; and Mr. James Beech, the Manager, has undertaken the duties in conjunction with his own.

At a recent meeting of the Mansfield Town Council, it was unanimously resolved to increase the salary of Mr. Arthur Graham, the Engineer and Manager of the Gas and Water Department, by £50 per annum.

Mr. Alonzo Dawes, who has held the post of Manager of the Clevedon Water-Works for upwards of a quarter of a century, has just been the recipient of a handsome cheque from the Directors, in recognition of his services, and on resigning the appointment he has filled with conspicuous success for so long a period. As already notified in the "Journal," he is to be succeeded by Mr. J. Harger Pye, who is also Engineer to the Gas Company.

Mr. W. Ewing, the new Manager of the Greenock Gas-Works, was entertained at the Royal Hotel, Hamilton, on the 21st ult., and presented with an illuminated address and a purse of money. The presentation was made by Bailie M'Hale, the Convener of the Gas Committee. Suitable acknowledgment was made, in the address itself, and in the remarks of Bailie M'Hale, to the excellent work done by Mr. Ewing at Hamilton since he went there in 1892. Provost Keith (who presided) also paid a high compliment to Mr. Ewing's abilities. On the same occasion, the health of Mr. J. Ballantyne, Mr. Ewing's successor, was proposed and cordially received, and fittingly acknowledged by Mr. Ballantyne.

OBITUARY.

The death occurred suddenly last Saturday of Mr. Rienzi Walton, M.Inst.C.E., one of the Inspectors of the Local Government Board. He was in his 58th year.

The death is announced of Mr. Seville Ward, who had been connected with the Ashton-under-Lyne Water-Works for the long period of 40 years. Under his late father, he discharged his duties faithfully; and eventually he became Manager of the works, which position he retained until his death. Although afflicted with blindness, Mr. Ward did a remarkable amount of work, which was always carried out most satisfactorily.

The death is announced as having occurred on Nov. 19 of Herr W. Dellmann, the Manager of the Municipal Gas, Electricity, and Water Works of Duisburg. He met his death from internal injuries received from colliding with a cyclist in June last. He was born in 1843, and constructed the water-works of Duisburg in 1874, and on their completion was appointed Manager. In 1880 the gas-works were also placed under his charge.

The last number to hand of "Progressive Age" (New York) reports the death of Mr. Donald Louis Cathels, son of the late Mr. E. S. Cathels, for many years Engineer of the Crystal Palace District Gas Company. The deceased was Assistant Engineer and Superintendent of the Louisville Gas Company, Kentucky. He only gave up work a few hours before his death, which occurred on Nov. 21. He was 44 years of age. He was at Louisville for 12 years, and previously with the Chicago Gas Company.

We sincerely regret to record the sudden death last Sunday, at his residence in Stanhope Place, W., of Dr. William Pole, F.R.S., who was for many years one of the Metropolitan Gas Referees—a position which he relinquished rather more than twelve months ago. We then gave so full an account of Dr. Pole's life-work, that it is unnecessary to do more now than record the sad event which has brought it to a close. We cannot refrain, however, from repeating the concluding remarks of the article which appeared in the "Journal" for Sept. 12, 1899, and again acknowledging the lofty sense of responsibilities and the fine conscientiousness which impressed all who were brought into personal contact with the deceased, and the kindliness and courtesy which endeared him to them. Dr. Pole, who was in his 87th year, survived his wife rather less than three months; Mrs. Pole's death on the 3rd of October having been recorded in our columns a few days later. The funeral service will be held at St. John's Church, Paddington, tomorrow (Wednesday) at 11.15.

Contamination of Water in Gasholder Tanks.—Dr. Rutten, of the Amsterdam Gas-Works, has come to the conclusion that bacteria play an important part in the contamination of the water in the tanks of gasholders with sulphuretted hydrogen, and in subsequently rendering the gas impure. This opinion has been formed as the result of bacteriological researches regularly made with the aid of pure cultures. M. Guéguen, the Editor of the "Journal de l'Eclairage au Gaz," suggests that Dr. Rutten's conclusion should be tested by submitting samples of contaminating water to bacteriologists for examination.

THE NEW GAS-WORKS AT SCHLIEREN, ZURICH.

THERE are two reasons, both of which take us back to last year's International Gas Congress, which make the following translated description of the new Zurich Gas-Works of unusual interest, and, it may be hoped, of instruction as well. The President of the Institution of Gas Engineers (Mr. J. W. Helps), when speaking at the opening banquet of the Congress, said the time had arrived when English gas engineers had to go abroad to learn the industry of which they were once the teachers. Instead of the engineers of other countries coming to England to study the latest methods of gas engineering, it was now to some extent the other way about. The teachers became the taught; and, in recent years, not a few English engineers had been to the Continent and the other side of the Atlantic to study the methods there adopted.* It is not everyone who has the opportunity of making such visits; and therefore it must be matter of satisfaction to have illustrated descriptions of some of the principal and latest works abroad brought under the eyes of those at home. That is one reason. The other is that among the papers read at Paris was one giving statistical information concerning Swiss gas-works, in which reference was made to the Zurich works, and on which considerable discussion arose, raising questions of much interest to gas engineers generally.† For these two reasons then, among others, no apology is needed for bringing the interesting new works in question to the notice of our readers. The gas engineer of to-day cannot be fully, or even adequately, informed with regard to the practice of his art and the latest means employed in the construction of gas-works, unless he takes into his consideration the views of his brother engineer abroad, more especially on the Continent.

It is interesting to note how, as exemplified at Zurich, the busiest town of Middle Europe, with a population of considerably over 100,000 inhabitants, the preliminaries in connection with building a new municipal gas-works are arranged. We see, first of all, a Commission of Experts called, followed by another, including the Engineers in charge of the Gas, Water, and Electrical Departments, all working harmoniously together for the common good, and laying down the general principles to be borne in mind. Then we have the Town Architect's help invoked, in whose office the designs for the buildings, and the plans for the drainage, &c., were prepared. Another department was charged, in part, with the testing of the various materials to be used; while the electrical staff of the town were occupied with the portion of the plant which particularly concerned them. Here it may be remarked how often one finds, in Continental gas-works, electricity serving such useful ends for both lighting and motive power purposes. At home, there seems to be some sentimentality which leads gas engineers of even high repute to divorce the one from the other. Abroad there is no rivalry between the two; and, in fact, a modern gas-works would hardly be considered complete without its electrical installation. At the Zurich works, for instance, there are 336 electric lights of one sort and another, and only 90 gas-burners. At first sight, it may seem strange to manufacture coal gas by the aid of the electric light, as shown in the retort-house illustrations; but, on consideration, its convenience and safety, and the facility with which it is used for isolated motors, show how justifiable is its employment. There must be many English gas-works where its advantages might be utilized. But to continue the account of the aid given by the other municipal departments. Difficulties arose with regard to the water supply, and negotiations with neighbouring communal authorities came to naught. Thereupon the town water office comes to the rescue, and lays a special main for the use of the gas-works. The same municipal care and co-operation are also shown in the elaborate establishment of workmen's baths of various kinds, even down to the minutiæ of soap and towels, in the building of workmen's dwellings, and, lastly, in the introduction of workmen's restaurants and boarding terms. Thus, in a variety of ways, have the Municipality of Zurich aided, as in duty bound, the building of their new gas-works, and contributed to the successful working of the undertaking.

There will be found in the following description mention of many constructional details of much interest. Of course, mechanical means have been adopted to the fullest extent for the different handlings of material; and labour-saving appliances have been introduced wherever possible. The coal is received, stored, carried to the retort-house, and carbonized, and the coke conveyed, loaded, and heaped, without being touched by hand. Needless to say, the inclined retort system of carbonization has been adopted; and, what may seem strange to some, slipping of the coal is unknown. The filling of the purifier-boxes is also done mechanically; and the description of it will be found interesting. Calculations of value will be noted; and the care which the smallest details have had bestowed upon them will be observed. All the machinery is in duplicate; and full allowances for all contingencies, examination, and repair of plant, as well as preparation for future extensions, have been made. Nothing has been left to chance. No mere rule-of-thumb has been followed; but everything has been scientifically and mathematically calculated. The works are an example of the modern spirit, in which nothing is taken for granted, nothing simply imitated, but everything based on sound knowledge and accurate fact. Of course, criticism of detail is always possible, and often profitable. Some engineers, no doubt, will question the advisability of retorts only 3·5 metres (or less than 11 ft. 6 in.) long, the suitability of the charging apparatus, and the economy of outside producers under the charging-stage. Some may even query the choice of such a water-logged site for the works, with its attendant difficulties and troubles. These and many other points may merit some criticism; but looking all round, admiration will be expressed for the excellence of the arrangement, the neatness of the design, and the thoroughness of the workmanship.

Among the names of the various firms to whom the work was entrusted, the total absence of any English maker will be remarked. Here is an important gas-works—carried out on a scale of great perfection, requiring the latest and best apparatus of all kinds, and high quality and character of work—executed without any assistance from any home manufacturers. Would such have been the case, twenty, or even ten, years ago? Let English gas engineers and contractors—formerly masters of the world's gas industry—reflect on this; and may it be to their advantage and profit. For them, and for all, we are convinced that nothing but good can come from the careful perusal and examination of the account of the modern gas-works hereafter given.

In concluding this introduction to Herr Weiss's work (which was originally written in German), we must express our indebtedness to our Zurich friends for the use of the original illustrations. In order to make them quite understandable by English readers, a translation has in all cases been appended to the words appearing upon them, so that no difficulty will be experienced in fully appreciating the different portions of the plant to which reference is made.

A.—GENERAL.

The absorption of the surrounding districts by the town of Zurich, which took place in 1893, as well as the rapid development in building, increased the consumption of gas to such an extent that in 1894 it became obvious that it was urgent to enlarge the gas-works. There were already three works at Zurich—those at Enge, making 2000 to 3000 cubic metres (67,600 to 105,900 cubic feet) a day; those at Riesbach, making 6000 cubic metres (211,800 cubic feet) a day; and the principal ones at Aussersihl, with a maximum daily make of 25,000 to 30,000 cubic metres (882,500 to 1,059,000 cubic feet). It was necessary, therefore, to know if these existing works could be advantageously enlarged so as to make the required amount of gas, or if new works would have to be built.

Before coming to a decision, the Municipal Council retained for consultation the Gas Managers of St. Gall and of Bâle—Herr Zimmermann and Herr Miescher respectively. These gentlemen, taking the average increase of 12 per cent. as a basis for succeeding years, advised the construction of a new gasholder, which should suffice up to 1898-99, when the building of new works would be unavoidable. The two sites of Hardhüsli and Juch, chosen by the Municipal Council, offered every advantage for building a gas-works. Herr Rothenbach, then Engineer to the Gas Department, made some technical criticisms on certain points in the report, but chiefly drew attention to the fact that extensions made to the existing works would only be sufficient for one year, and that their cost would be excessive. The report was submitted to a second Commission of the Works Department, consisting of Herren Blum (Engineer), Peter (Water Engineer), and Rothenbach (Gas Engineer). The report of this Commission, dated Aug. 7, 1895, arrived at the following conclusion:—

(*a*) The average increase in the consumption of gas during the next five years is expected to be—

In 1896 and 1897	10 per cent.
,, 1898 and 1899	8 ,,
,, 1900	7 ,,

(*b*) It is necessary to increase the producing plant; and, in fact, the new works ought to have been in use by the autumn of 1895. It is certainly impossible to get a greater production from the existing works, or to enlarge them, owing to the great expense it would incur. The building of a new bench of retorts in reserve for this autumn is already required, so as to keep up with the demand for gas up to 1897. The proposals of the former experts on this subject are not practicable.

I may add here that the actual increase in the gas consumption exceeded all estimates, and was as shown by the following figures:—

1896.	1897.	1898.	1899.
25·6 per cent. ..	17·2 per cent. ..	17·23 per cent. ..	15·3 per cent.

The necessity for a new works being proved, there remained to decide upon the site, which should be based on the following considerations:—

Height. (The works ought to be situated, as far as possible, at the lowest point in the distribution system of lighting.)
Coal transport.
Nature of the ground.
Price of the ground.

Preference was given to the Juch (Schlieren) site, which fulfilled the conditions summed up below.

1.—Satisfactory height.

2.—The fact that the North-Eastern Railway Company declared themselves ready to accede to connecting the sidings at Schlieren, which was not the case at Altstetten. Even if the federal department of the railways had obliged the North-Eastern Company to consent to a junction being made at Altstetten, the

* See "JOURNAL," Vol. LXXVI., p. 580. † *Ibid.*, p. 634.

buying of the land and the making of the new lines would have meant great expense; and the future enlarging of the works would have been impossible, because of the speculation in the neighbouring land that is sure to take place shortly.

3.—The land at Schlieren is very suitable for the building and future development of the works; while the shape of the land at Hardhüsli would have allowed of only using 70 per cent. of it.

4.—The Schlieren site is, therefore, more favourable than that of Hardhüsli.

5.—The extension of the leading gas-main will cost much less than a railway-siding at Hardhüsli. The North-Eastern Company were, moreover, disposed to make and maintain at their cost the siding at Schlieren Station, as well as the permanent way up to the branch line into the works.

6.—Yearly economy in the cost of coal carriage. Compared, therefore, with its chief advantages, the gas leakage and the inconveniences arising from the length of the leading main, as well as the increased cost of carrying bye-products to Zurich, the necessity of obtaining a right-of-way for laying the main, the greater difficulty of superintendence, &c.—all these appeared the less important drawbacks.

The Municipal Council then, having decided the question of principle and of site, nominated, on July 4, 1896, a Commission consisting of Professors Ritter and Stodola, of Zurich, and Herr Mathys, Gas Manager at Chaux-de-Fonds, to whom were added the Gas, Water, and Electrical Engineers. This Commission of Experts had to examine the plan and general arrangement of the works. Owing to the urgency of the matter, they first of all only considered the principal questions; the examination of internal technical details of the scheme taking a secondary place, as requiring more time. This expert report (which was completed about August, 1896) came to the following conclusions.

Necessity of the Work.—The increase in the gas consumption has exceeded all the estimates made up to the present; and it is more than probable that this increase will be maintained at the same rate for some years. The same difficulties will unavoidably be repeated during the winter of 1897-98, if a thorough remedy be not taken in hand. There is no other solution than building a new works, as the extensions contemplated at the existing works of Limmatstrasse and Hornbach would hardly have been enough for one year.

Capacity of the Works.—New plant for at least a make of 25,000 cubic metres (882,500 cubic feet) per day ought to be ready for work by the autumn of 1897. The modern apparatus of the new works should very much reduce the labour. The works should be prepared for extensions at successive periods of ten years, as a daily consumption of 100,000 cubic metres (3,530,000 cubic feet) may already be foreseen.

Site.—The Commission approves of the site chosen by the Municipal Council.

Arrangement and Plant.—The experts are agreed on the general arrangement of plant, machines, and buildings; but they reserve for themselves the further examination of details.

We still have to glance at the general aspects, which determine the arrangement of railway lines and buildings. (See General Plan, fig. 1.) They may be considered under seven heads.

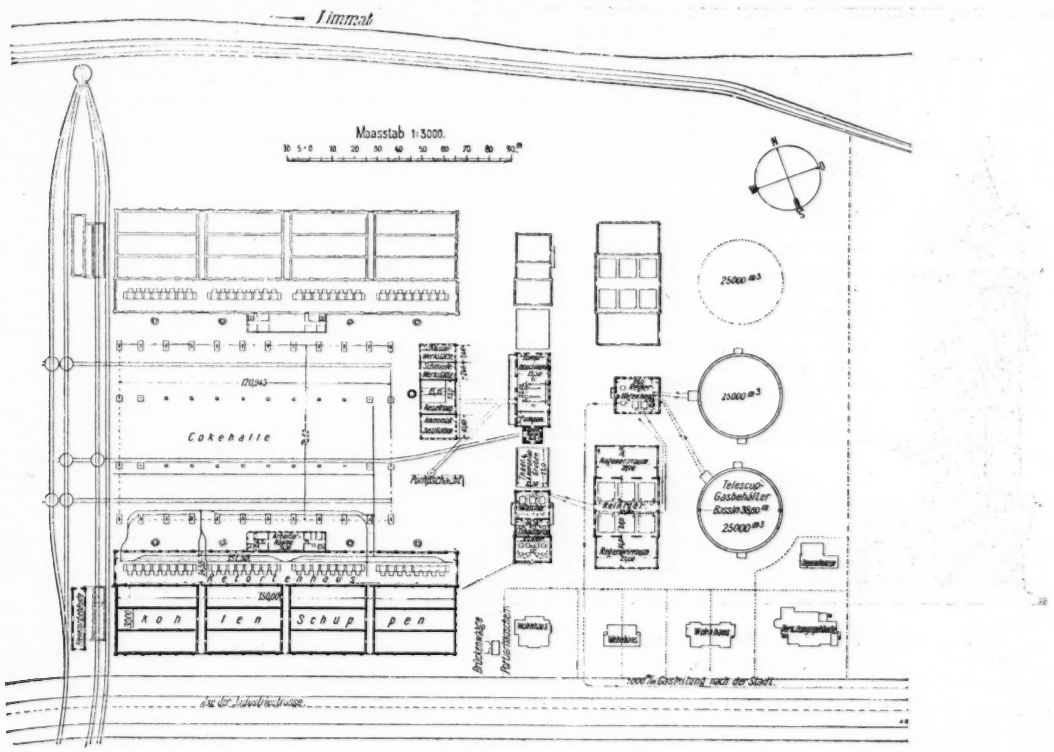


FIG. 1.—PLAN OF WORKS. Scale 1: 3000.

Cokehalle	Coke-Store.	Wascher	Washer.
Retortenhaus	Retort-House.	Exhaustoren Kuhler	Exhauster and Condenser.
Kohlen Schuppen	Coal-Shed.	Regler and Uhrenhaus	Governor and Station Meter House.
Elevatorgebaude	Elevator-House.	Regenerirraum	Revivifying-Floor.
Arbeiter Räume	Workmen's Rooms.	Reiniger	Purifiers.
Brückenwaage	Weighbridge.	Telescop-Gasbehalter, 25,000 m³	Telescopic Gasholder of 882,500 cubic feet capacity.
Portiershäuschen	Porter's Lodge.	Wohnhaus	Dwelling-House.
Schlosserwerkstätte	Fitting-Shop.	Verwaltungsgebaude	Store.
Schmiedewerkstatte	Smith's Shop.	Limmat	River Limmat.
Kesselhaus	Boiler-House.	Axe der Industriestrasse	Centre of Street.
Ammoniakdestillation	Liquor-Works.	1000 mm. Gasleitung nach der Stadt	Outlet Main to Town.
Dampfmaschinenhaus	Steam-Engine Shed.		
Theer-Ammoniak Grube	Tar and Liquor Well.		

1.—The greatest possible protection for the works.
2.—Reduction of all incoming and outgoing carriage on all kinds of material.
3.—Sufficient stores for reserves of raw material, in case of war or strikes, as well as coke-stores large enough to allow of maintaining a firm price.
4.—More economical working, independent of the individual capacity of the workman.
5.—Partial building of the whole of the works without prejudicing future extensions.
6.—Possibility of keeping up a regular make, even when some of the apparatus will not be at work.
7.—Possibility of controlling each of the different parts of the works.

The scheme allows for building a works reaching, when completed, a maximum make of 100,000 cubic metres (3,530,000 cubic feet) per day. The works are made up of four sections, each of a capacity of 25,000 cubic metres (882,500 cubic feet) per day, and able to be carried out in accordance with the requirements. The retort-house is to accommodate two benches of retorts, and will be of a size suitable for making from 50,000 to 60,000 cubic metres (1,765,000 to 2,118,000 cubic feet) per day, including a safe reserve of one-quarter. It was thought advisable to mention these general considerations, which it seemed might be of some interest and use in understanding the arrangements adopted. Before considering the plant itself, we must not altogether overlook the erection of the buildings; nor their foundations, which have been very difficult to execute.

B.—Buildings and Foundations.

The Municipal Council entrusted this work to the Town Architect's (Herr Geiser's) Department, though the work was more particularly given to the office of the Architect, Herr Oechslin. Owing to a sheet of underground water, which made it very difficult to give the buildings the required sustaining power, the work had to be very carefully done, and with special materials. The gravel-bed of the subsoil is formed of undulations, the length of which varies very much, and which extend right across the works like a plain, running from the north-west towards the River Limmat. The difference of level in these curves is something considerable—varying from 2 to 12 metres (about 6 ft. 6 in. to 39 ft. 4 in.). When the Limmat and the Lake of Zurich are at low water, that in the subsoil is found only 2 metres (about 6 ft. 6 in.) in the pervious earth below the ground-level. The height of this underground water is 374·5 metres (nearly 1230 feet) above the level of the sea. [This will be referred to again in connection with the mains.] The level of the entire surface has had to be raised 75 centimetres (29½ inches), so as to avoid the floods which might occur as long as the River Limmat is not fully controlled, and as, consequently, the level of the underground water is so high. This raising of the ground-level has made safe all the underground plant, such as the coal conveyors, pipes, &c.; but it has involved enormous expense, which was further increased by the difficulty of reaching the gravel-bed for the foundations.

The weight carried by the layer of gravel has been in some places as much as 6 kg. per square centimetre (85 lbs. per square inch); but generally it was only 4 kg. (57 lbs. per square inch). The load of the retort-arch foundations, which were built on piles, was 2·8 to 3·5 kilos. per square centimetre (nearly 40 to 50 lbs. per square inch) at the maximum. The foundations of the subways containing the carrying systems are those which are of most interest. They are in portland cement concrete from bottom to top. The foundation itself, in clinker concrete, carries a covering on the Monier system. The maximum pressure of the water at this depth of some 4·5 metres (about 14 ft. 9 in.), and the water in the subsoil at this point, were considerable; so much so, that from 8000 to 12,000 litres (1760 to 2640 gallons) of water per minute had to be pumped for three weeks without stopping, in order to make possible the concreting of the bed, which had to be covered with a tight Monier facing of iron-wire netting, placed in portland cement. The side-walls also have similar lattice-work up to a height of 394·2 metres (nearly 1293 feet) above sea-level. This netting,

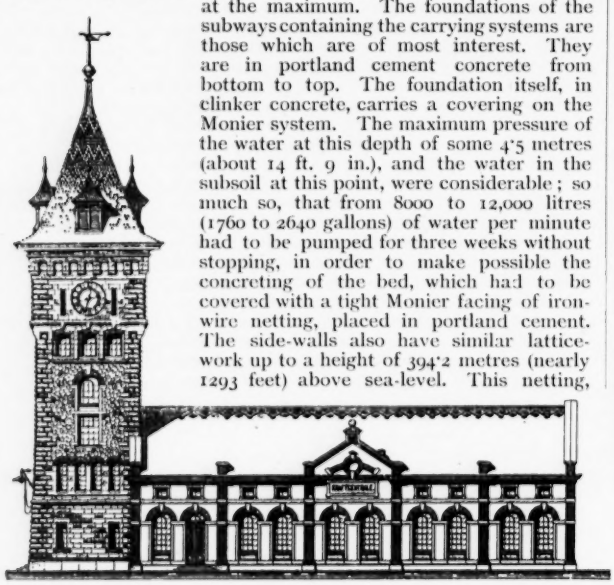


Fig. 2.—Water Tower and Central Power Station.
Scale 1 : 500.

or lattice-work, is used according to very exact instructions. In our case, it is composed of 7·5 millimetres (0·295 inch) iron rods, joined together where they cross by 5 mm. (0·197 inch) round iron hooks. The hooks are let into the concrete sides to a depth of 10 cm. (say, 4 inches), and form the only points fastening the lattice-work. The round bars of the netting go in between these stays, and are tied by 7 mm. (0·276 inch) iron wires.

Different materials are used, according to the character and estimate of each building. The bases of most of the buildings are in Gothard granite, except those of the workmen's house, the porter's lodge, and the engine-shed, which are in limestone, *molasse* (a prepared stone) of St. Marguerite, and portland cement. The façade of the retort-house, up to the window-sills on the first floor, the water-tower, and the base of the governor-house are in free and lime stone, as also are the fronts of the coal-sheds, elevator buildings, houses for apparatus, purifiers, meters, and the electrical station. The different façades of the retort-house, from the arches of the windows to the roof, as well as those of the annex for the pumps and engines, workmen's house, bath-rooms, boiler-house, workshops, and also the porter's lodge, are in solid masonry of brick and cement. The locomotive-shed is in rough masonry, with brick face-work. The retort-house and the buildings for the condensers, other apparatus, and purifiers have all iron roofs and ventilators, and are covered with tiles. The roofs of the governor-house and the electrical station are covered with slates. The curved roof of the coal-sheds is also in iron, covered with corrugated sheeting, with a ventilator. The flat roof of the elevator building is made up of I-irons and of brick arches covered with a layer of concrete, cement, and asphalt. The inside and outside staircases, the door and window framing, the roof cornices, cap-stones, and brackets, are all in Gothard granite. The longitudinal and transverse walls of the coal stores, as well as the arches of the conveyor channels, are in portland cement set between I-girders. Of course, all these materials give complete security from fire, and are adapted to the requirements of the different roofs, floors, and windows. They have all proved satisfactory up to the present. Fig. 2 shows one of the most interesting buildings—the water-tower and electrical station.

C.—Railway Lines. Carrying and Storing of Coal. Carriage of Bye-Products.

Construction of the Railway.

The gas-works are situated 1·6 kilometre (1 mile) above Schlieren Station, to which they are joined by a railway line, which has a gradient of 1·6 in 1000. This junction with the North-Eastern Railway, on the way from Zurich to Baden, is made by a single line, which forms a loop to the main line. In addition, there is a direct line between Schlieren Station and the works, which allows independent traffic on the main line. The works line runs alongside of, and passes, the cantonal route of Engstringen, then divides into two lines, each 250 metres (about 274 yards) long, which are used for the arrival and departure of goods trains. These two lines are again each separated into two more, 130 to 180 metres (about 142 to 196 yards) long. According to agreement, the North-Eastern Company have to bring the railway waggons on to the sorting way, where also they receive them again; while the works have to look after the moving of separate waggons up to Schlieren Station. A weighbridge, placed on the main line, checks the weight of the materials which come into or leave the works, without interrupting the traffic. After passing to the level of the pointsman's house, the lines are subdivided into four. The north line is used for empty coal-waggons, as well as for those loaded with coke, tar, and ammonia. The two lines in the middle are especially for carrying coals; while the south line, at present used as a contractor's line, will later on become a goods line, and will be continued as far as Zurich. A branch line taken from the last-named leads to the locomotive-shed.

In the works themselves, the railways are on the west side, and are arranged as follows: The three principal lines above mentioned, one of which is divided into two, end at the side of the Limmat at a turntable 8 metres (26 ft. 3 in.) in diameter. Three lines, starting at right angles from the four preceding ones, lead to the coke-sheds, the middle one going as far as the central building (ammonia and water tower). Six turntables, 6 metres (19 ft. 8 in.) in diameter, allow the line of route to be changed. The railways will be amply sufficient, even when the works will have doubled themselves. Their total length is 4520 metres (4943 yards), with nine points, crossings 1 to 8, seven turntables, and five right-angle junctions. The section of the rails was chosen from the Sihl Valley Railway. The lines are fastened on hard-wood sleepers, except at the points, where there are metal ones. A locomotive of 100-horse power, with two coupled axles on the Krauss system, of Munich, is used for moving the waggons. The figures which follow justify the use of a locomotive, besides which 2400 wagons were received during the building of the works. The actual yearly traffic reaches in all 8000 trucks:—

Coal carriage	4800 waggons.
Coke	2600 ,,
Tar	250 ,,
Ammonia	50 ,,
Different materials	300 ,,

When the building of the works was begun, the negotiations with the North-Eastern Company and the Commune of Schlieren had not been completed, so that a temporary line 1·6 km. (1 mile) long had to be laid down, which joined the goods siding of the Geistlich works near Schlieren Station.

Carrying and Storing of Coal.

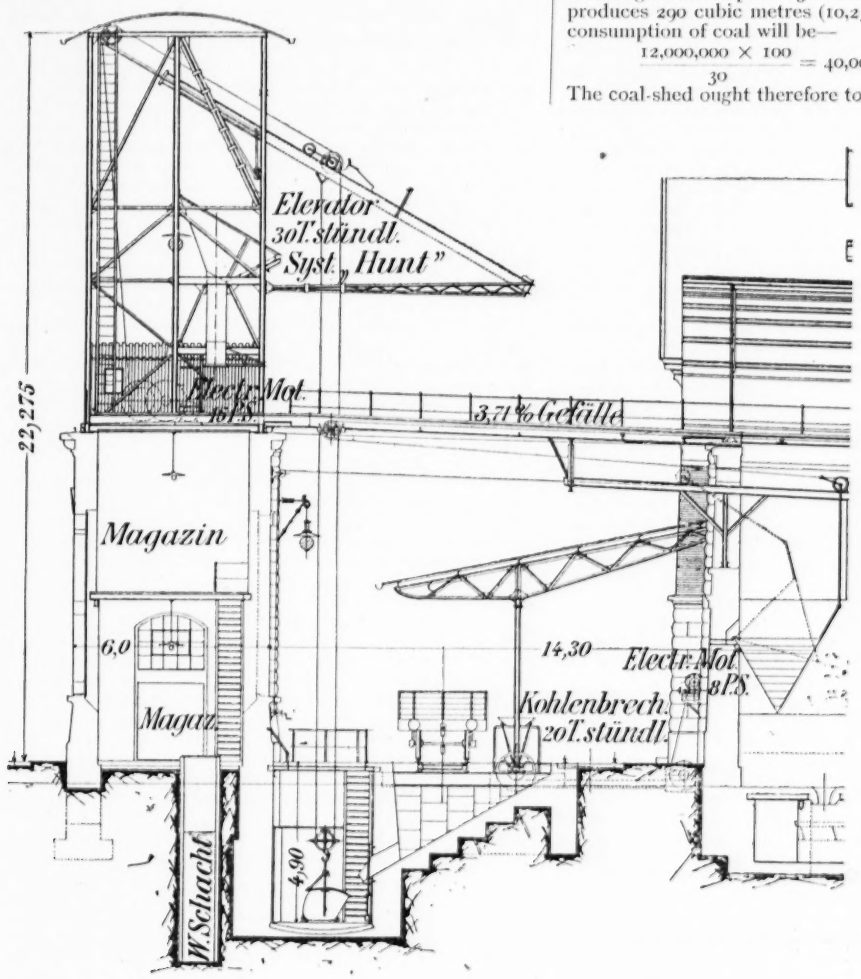
The storing of the coal is a very important question, because of the necessity of reducing the labour, and so as to depend no longer on the individual efforts of the workman. The ideal solution would have been to have erected an elevated railway, on which the coal-trains would have run directly into the stores. The formation of the land did not allow of this scheme being carried out; and it would also have been very costly. Moreover, a railway was wanted for carrying the bye-products on the yard-level. A scheme was thought out of a hydraulic elevator for raising the waggons (which would not have done away altogether with laying down a yard-level line), and a second one for raising the bye-products to the level of the coal railway lines. These schemes were too expensive to work, and had to be abandoned. The examination of the most modern methods of carrying and emptying waggons—such as that used by the Westphalie-Rhénane Coal Syndicate, at Mannheim, that of the coal silos on the Possehl system in the Free Port of Hamburg, as well as similar installations in the gas-works at Copenhagen, Berlin, Altona, Fredericksburg, Charlottenburg, &c.—showed that the Hunt elevator, in conjunction with the Hunt automatic trucks, was the most convenient system of transport for the Schlieren works. Professor Stodola (an expert as regards mechanical installations) has praised the Hunt system very much in his report on the very ingenious arrangements at Copenhagen and Mannheim.

The works store exclusively small or broken coal, which passes first of all through a breaker of 20 tons per hour capacity (Plate I. and fig. 3), placed between two lines, so that the coal falls direct from the waggon into the funnel of the coal breaker. The coal

shed (Plate I.) is 152 metres long and 30 metres wide (about 498 ft. 6 in. by 98 ft. 5 in.). It is divided into four principal stores by three cross partitions, which are themselves again divided into three longitudinal compartments. This division has been adopted so as to allow of separating the different kinds of coal, and as a prudent step against any danger from fire. The bottom of these stores is formed of two inclined planes, of which we shall speak later on. The stores should be able to hold one-third of the coal required for a yearly make of from 12 to 14 million cubic metres of gas (say, 424 to 494 million cubic feet). Reckoning that 100 kilos. of coal give an output of 30 cubic metres of gas, and that a retort produces 290 cubic metres (10,237 cubic feet) per day, the yearly consumption of coal will be—

$$\frac{12{,}000{,}000 \times 100}{30} = 40{,}000 \text{ tons} = 4000 \text{ waggons.}$$

The coal-shed ought therefore to contain 15,000 tons (metric).



GERMAN DESCRIPTION.

(1) Elevator 30 T. stündl. Syst. "Hunt."
(2) Electr. Mot. 15 P.S.
(3) 3·71 % Gefälle.

Magazin.

22·275 .. 6·0 .. 14·30

(4) Electr. Mot. 8 P.S.
(5) Kohlenbrech. 20 T. stündl.
(6) W. Schacht.
(7) 4·90.

ENGLISH TRANSLATION.

(1) Elevator (Hunt's system) to deal with 30 tons per hour.
(2) Electric Motor, 15-horse power.
(3) Slope, 3·71 in 100.

Store.

73 feet .. 19 ft. 8 in. .. 46 ft. 11 in.

(4) Electric motor, 8-horse power.
(5) Coal-breaker, to deal with 20 tons per hour.
(6) Water-pit.
(7) 16 feet.

FIG. 3.—TRANSVERSE SECTION OF THE ELEVATOR HOUSE AND CHARGING HOPPER INSTALLATION. Scale, 1 : 200.

[Detail of Plate I.]

A far-seeing management should store quite sufficient for three winter months' supply, in case coal happened to be short for any reason whatever—strikes, war, &c. The average daily consumption is 14 waggons; but November to January, inclusive, counts as the third of the yearly amount used—that is to say, about 13,300 tons. Assuming an equal consumption all the year round, the average for a month would be 3330 tons. But the coal used being much greater during the winter months, sufficient reserves ought to be provided to meet them. We can get an idea of the capacity of the coal-stores from the following working figures.

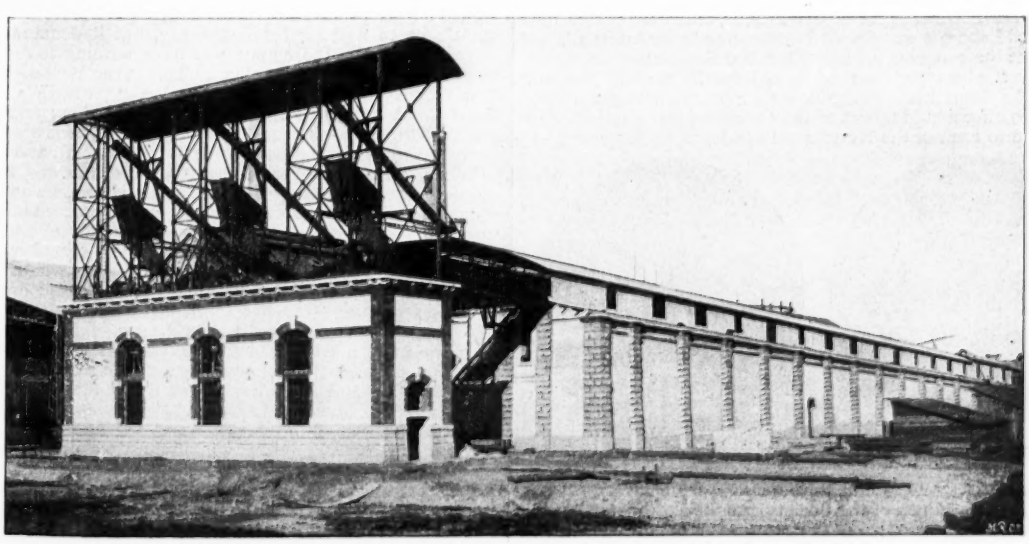


FIG. 4.—VIEW OF ELEVATOR HOUSE AND COAL SHEDS.

Allowing that 1 cubic metre of coal weighs 870 kilos., 16,000 cubic metres are required to store 1400 waggons, which gives a bed of coal of an average height of 4 metres (over 13 feet). Such a height is perfectly allowable, and does not cause any danger of spontaneous combustion for coal from the Saar and Ruhr mines. Unfortunately, the arrival of coals is not always regular—either by fault of the mines or of the railway companies—varying as it does from 5 to 50 waggons per day. These are the reasons which determined the size and units of the storing arrangements.

Three elevators, of a capacity of 30 tons per hour, are connected with three automatic trucks of a capacity of 30 to 40 tons per hour. If one of the elevators is out of use, the two others are sufficient to unload a large number of waggons without stopping the coal traffic. (The longitudinal section of Plate I. gives a very clear idea of these arrangements.) In an empty space left under and between the railway lines, close to the elevator building, and on the same centre line as the elevators, are three large hoppers. The sides of these are made of strong sheets, 3 mm. (0·118 inch) thick, which allow the coal to slide easily. The waggons are brought directly over the hoppers; and on opening their moveable sides, they are to a great extent automatically emptied. The rest is done by shovel. Six waggons may be emptied simultaneously. Each hopper is supplied with an easily-worked vertical door, which stops the fall of the coal (see details on fig. 3). The coal drops from this hopper into one of the elevator skips of 800 litres capacity. The Hunt elevator is itself an ordinary lift, arranged so that when the skip arrives at the terminal point, it runs along a light horizontal pathway, and on being automatically thrown out of gear is emptied into a storage-tank. The mechanism of this elevator is driven by a very solidly-made electrical windlass.

A well-contrived brake controls the drop of the empty skip, which falls by its own weight. The normal power required for lifting a full skip is 15½ horse. The skips are emptied into an end hopper through a horizontal slide, which allows the coal to be put into the trucks of an automatic train. Briefly described, this is made up of an inclined iron frame (in our case the roof principles), on which is placed a narrow guide-run with a 3 per cent. gradient, together with a truck and counterweights, cable, and pulleys. The bottom of the truck, which has a capacity of 1½ cubic metres, is in the form of an ass's back. Its lateral sides hang on top hinges, and are kept in place at the bottom by a lever.

The truck is filled under the coal-tank, and then pushed on to the inclined line. Once started, it increases in speed up to the point where it has to be emptied. A little in front of this, a traverse or buffer is placed on the line, and strongly fastened to the cable. The latter is fastened to the upper end of the inclined track, and raises a moveable counterweight on a fixed point, by means of pulleys. The counterweight is raised by the truck itself coming against the buffer, which, by so doing, produces the power required. When the truck is to be emptied, it runs between two flanges placed alongside the track, and fixed to the moveable traverse. This flange throws the mechanism of the levers out of gear, the lateral sides of the truck open, and the coal falls into the store. The counterweight then returns to its place, gives a strong impetus to the empty truck, and sends it back to the starting-point. The coal is thus stored entirely automatically, without the need of any outside aid. The man told off to look after the elevators can also easily manage the trucks. Only two men are required to look after the elevator, and to store the coal. The arrangements just described have worked successfully since the middle of November, 1898. Some 25,000 tons of coal have been stored in this way, without any difficulty, during ten months; and the wear and tear and repairs have been insignificant. Fig. 4 shows the house for the elevators, and the coal-stores.

(*To be continued.*)

Medal for the International Gas Congress.—At a recent meeting of the Société Technique du Gaz en France, under the presidency of M. Alfred Lebon, it was decided that, owing to the international character of the congress held in Paris last September, the usual awards for the best papers read would not be made. Instead, however, the Committee arranged, with characteristic generosity and tact, to offer a gold medal to the President (M. Vautier), and a silver one to each of the Honorary Presidents of the congress.

Further, a silver medal has also been presented to all the contributors of papers; and they have already been received by those entitled to them. We give a reproduction of the medal. It has on one face the names of the Society and the author of the paper presented at the congress; and the reverse is a panoramic view of Paris, with, overhead, a flying figure, bearing in each hand a flaming torch, emblematic of the gas industry.

COMMUNICATED ARTICLES.

GAS MATTERS IN THE UNITED STATES.

One familiar with the history of illuminating gas development in the States cannot be for any long time an intimate of the places in which the younger and more to-thought-given members of the gas engineering profession congregate, without being impressed by their attitude towards the business, as shown by the drift of their conversation and the methods of discussion, rather than by any distinct statements made. This is specially true when they are sure of their companions; for it is distinctly noticeable that they do not always speak freely, and that they are somewhat restrained from expressing themselves by the presence of "men of age and experience." Under the circumstances of choice, however, the conversation among these mutual confidants runs to the question "What next," with the most surprising regularity.

Distinctly not satisfied with the present, they seem in doubt as to the future—not financially, for never was the business shown by the station-meter to be in more prosperous condition, but scientifically. They appear to find themselves face to face with some great impending change, for which not a few are anxious; and yet none seem at all sure what that change will be, nor how it will be effected. Some apparently anticipate a great advance in methods called into being by the more extended education of the younger men—some new departures; others seem to expect development along lines pioneered long ago, when conditions prevented further development; while others again appear to foresee not only a return to abandoned lines of development, but also a repudiation (so to say) of much which has for a long time been regarded as distinctly forward movement in the direction of perfecting operations and processes. At times, earnest discussion of the last new machine will give them occupation, and again some question in regard to the chemistry and physics of gases. The chemistry in which they find interest is not the analysis of gas mixtures. The brighter men have passed this by to the lucubrations of the special experts; and if close attention is paid, it will be noted that their problems and propositions all belong to the synthetical, and not to the analytical, side of chemical investigations.

Patient listening makes it clear that the goal of their desires—often, indeed, a goal unrecognized by the earnest talkers—is a gas whose flame shall be not luminous but hot, a flame giving not greater candle power but a higher temperature, and endued with calorific possibilities more intense than any gas at present in use. Thermal units are more desired than candle power, to put it in one way; more amplitude in the vibrations of the atoms in the flame, to put it in another. Often, indeed, does one hear such phrases as "Of what use is luminosity with the mantle?" "What we want just now is heat, and plenty of it," "A luminous flame stands for soot," or "One wants B.T.U. not candle power to run an engine." Such remarks coming from such men, show that a storm of some sort is coming down the wind. Only a few hours ago, as it were, a man famous for his studies said in my hearing: "Hydrogen will heat a mantle as well as will acetylene, or better; it will certainly drive a gas-engine as well, or better; and it makes no soot." Examples of such remarks can be multiplied indefinitely—all going to show that the ideal before the minds of the younger men is no longer, if it ever was, an intensely luminous gas-flame, but one extremely hot, beyond all things one which shall be smokeless, even though its light be limited to the utmost insignificant glimmer.

To what can we attribute this remarkable change in the point of view? Surely we need look no further than the lamp by whose light I am writing, and the engine whose "stuzz-stizz-tiff" which I hear proclaiming that it uses the "Otto" cycle. The mantle cares nothing for luminosity, but it demands, and will have, heat; while the engine will have nothing to do with a gas which it does not burn up clean. This is the ideal with which the new century begins in certain circles, "Wanted, a gas whose flame is not intensely luminous, but intensely hot; and if possible an entirely smokeless gas." This demand spells hydrogen, but acetylene never, never, never, nor none of its kith and kin.

When, in opposition to Professor Vivian B. Lewes, I voiced my opinion that the attempt to introduce acetylene as an illuminant must fail, as being at strife with the most powerful tendencies of development in the gas industries—in point of fact, was an attempt to put the clock hands backward—I had no hope that my judgment would so soon be vindicated by events. But so it happens. Heat, not luminosity, has become the desideratum; and the possibility—yes, certainty—that unconsumed carbon will rapidly destroy the engine, makes it impossible that an increase in "precipitable hydrocarbons" will be encouraged. I was the first man in America to try the experiment of driving a gas-engine with acetylene. As a motive power it did well enough; but the bill of repairs "was out of all cess."

If the direction of the development tendency is to be towards calorific power, and not towards luminosity, the ideals of development will indeed change both rapidly and widely; and if we admit that this new direction is the one in which we are to make our way, what does it imply? What would it signify were the change which so many trifles indicate to become an accomplished fact? Recently a man who had made gas these forty years, and whose name and fame as a gas-works engineer is known wherever

English is the spoken tongue, remarked at a meeting in New York: "With these perfected mantles, any old gas is as good as the best." Another famous engineer said quite recently in my hearing: "The fate of the luminous gas-flame is sealed. The mantle has condemned it; and the gas-engine has confirmed the sentence. Between these two—the mantle and the gas-engine—the luminous flame is doomed. The end is not yet; but it is coming. We have made an engine with a working weight of only 18 lbs.; and with gas at the present price, this is cheaper than doing it yourself."

In fact, so certain is the combined action of these two factors to change the course of development, that the interests which would be endangered were these ideas to get commonly spread about among consumers have already taken the alarm. They are in the condition of the men in the cartoon, "We are not frightened, but let's run a bit." Urged by no possible motive, except the stimulus of their own fears, the men who are interested in the enriched gas industry are repeating the very arguments, and often the same objection in the same words, which were used against them about fifteen years ago. Just as the "coal gas men" said nice things about the "water gas men," so with the change of times and customs if a man voice the idea that a mantle and the flame of a non-luminous gas, not a non-luminous gas-flame, is the proper caper, the "enriched gas men" give tongue at once. Their chief apparent argument is that the dear public do not want the change, and that the bad young men are trying to impose on the said dear public, which talk is part humbug (about two-thirds), and the rest is the humming of the disturbed hive. Still, the change to non-enriched, and therefore non-luminous, gas is certain to come in time. But it will not be for a while yet; and the men who are so distressed at the folly of "these youngsters," will be able to draw their dividends with undisturbed equanimity for the rest of their natural lives. The young men are, however, discussing the possibility of the change, and its advantages; and in such connections it is well to remember that the ideals of the young become the accomplished facts of later life.

Another factor which is a fellow fighter with the gas-engine and the mantle in the battle of the non-illuminating gases for the supremacy, is the gas-stove. Here also no one cares for candle power; heat units are all in all. At the Denver meeting of the American Gaslight Association, the chief interest was raised by a communication on the methods of increasing consumption; and the paper and those who discussed it alike found the solution in gas-stoves. The logic of the situation became so plain towards the end of the discussion—that the consumption from gas lighting could not increase any faster than the building of houses, while the others are not only soil as yet untilled, but a market which will have a constantly growing demand—that the members are still talking about it, and the meeting was a couple of months ago. One engineer who was present at the meeting at Denver expressed his feelings by saying: "We drove nails, no spikes, in the coffin building for the illuminating gases. I tell you the fuel gas is the card to bet on in this game. The only question is if your pile is big enough to sit out the game."

Another remarkable feature of the situation is the condition of the electric light industry. Of course, the electric light companies are in theory the rivals of the gas lighting companies in every town in which both exist. In point of fact, they are often owned by the same men. Sometimes they have the same boards of directors; the administrative officers are usually different, however. Under these circumstances, the rivalry in management is, of course, extreme; and both administrations are on their guard to waste nothing and to gain everything. Yet in nearly every case in which the consumption is limited in quantity by the demand rather than by the supply, the gas administration shows that it has made money, while the electric light administration has not done so well, or has lost. Absolute certainty is not obtainable, except in a very limited number of cases; but the evidence goes to show that the stock of a gas company is a better asset than the stock of an electric light company, at least in the average town. Reason, as before—electricity is mainly used for lighting, gas for light and heat and power as well. Not a few American towns have found it cheaper to have gas-engines to lift water for the town supply, and purchase the gas of the local company, than to put up and maintain a boiler-plant at the present price of fuel.

A further interesting development in the gas business is the change in the ownership. In nearly every case, when the gas-works were first built, a corporation represented the ownership, and the shares were scattered widely; often a number of names being represented by only one share to each in the original subscription list. This state of things specially characterized the early companies; the later works usually are erected by a capitalist who intends to make money by selling his stock or bonds, after the fashion of a railroad with a land grant. This system of many owners, and *bonâ fide* stockholders' meetings, with all the petty politics and jealousy which characterizes a vestry, has given way to a system of larger proprietors, so to say.

A "syndicate" will own not only one, but half-a-dozen gas companies. The U.G.I. is only "a big swallower." What it does in the big way, a dozen of imitators do in the small one; and this system is often as satisfactory to the minority as the other. The consumer will growl anyway if he is not a stockholder; but the last new departure is quite new. Certain men have taken to buying gas-works with the intention of running them as a "personal business." Just imagine the situation, if this is not a case for the monopoly howlers. The system has not yet developed far enough to see just how it is going to work; but it promises well. The idea that the actual owner of the gas-works is their fellow-townsman, that they can go to him and complain, seems to have taken the edge off the relations of not a few gaslight companies. At present the number of corporations which have been swallowed by one man is small; but the swallowing has been done often enough to interest the student of industrial development here in the States.

One sees also a disposition to invite men to purchase responsible places by buying stock in the companies they wish to serve. This policy no doubt has its uses. Maybe it has advantages even as compared with some others; but it sometimes brings about results very far from those intended. More than one astute manager, by purchasing some stock and obtaining proxies for more, has become the controlling personality in the company he serves. This proceeding has brought about some very amusing *contretemps*. In one case recently, the president of the company objected to something the manager had done; and when he expostulated with him, the manager blandly told him if he did not like the policy of the company he could resign. If he wanted to sell, the manager was ready to buy his stock—paying the market price for his holding. It is said that the president did not sell, but revenges himself by speaking of "Mr. X's company" when he meets any of his fellow directors.

Among the notable happenings at the Denver meeting, perhaps the most notable was the discussion which took place—if one may call such an interchange of remarks a discussion—on "Uniform Methods of Accounting." The importance of this matter to the companies here in the States arises from two causes—local laws and foreign ownership. Owing to the number of local sovereignties (there are only 53 in all, "free and independent" every one of them), the gas companies are very likely to find themselves face to face with a different accounting system every few miles, as it were. It should also be remembered that some corporations own gas companies—not simply manufactories doing business, but the corporations themselves; and there are cases where a corporation "A," owning as corporate property another corporation "B," which in its turn owns, in the same way, a third one, may be required to keep their accounts in a different way for each one of the three.

It is stated by a "corporation lawyer" that the following is also possible: "A New Jersey corporation own property in Iowa, Ohio, Wisconsin, and Texas. Each has, or is supposed to have, a system according to which the accounts of all corporations doing business in its domain are kept. By this system, not only the local ledgers, but also the administrative accounts, so far as the local business goes, must be kept in every State in which they do business. The result is five distinct systems and sets of books, with no end of confusion. Pipe renewals, which in some States are left to the discretion of the directors, are in one State charged to capital account, in another to maintenance, and in a third to expenses, while in a fourth new pipes laid in a new street are charged to capital account as being an actual investment, while if a new pipe is put in in place of a smaller one, or one worn out, it must be charged to expenses account. In still another the difference in the first cost of the two pipes is to be charged to the capital account. Hence no one can say what the value of the property actually is; and the value is really at the mercy of legislators, easily influenced by public clamour, and totally ignorant of the details of corporation management." Moved by this unpleasant state of affairs, certain electric light companies have been trying, by means of a skilled accountant, who is working quietly, to bring about an agreement among the different large companies by which a uniform accounting system shall be established; the intention being when it is definitely formulated to get it enacted by all the Legislatures in the United States. A gentleman greatly interested in this matter came before the Denver meeting and invited the co-operation of the gas companies.

The above explains the situation; and this is approximately what happened—leaving out all details not essential to show the *animus* of events. The visitor expressed his views of the matter at some length, and (it seemed) quite moderately; but his winged words did not seem to home. Perhaps too few business men were present. In the end, only the perfunctory resolutions of thanks, and a committee to co-operate, were passed. This lack of appreciation of his efforts seemed, I thought, to provoke the visitor a bit; and he said: "If you do not act for yourselves, the Legislatures will act for you; and it will not be friendly action either." These may not have been his exact words; but they are his words as I, and a number of others, understood them. This frank admission rather surprised me; but there was more to come. Just as the meeting was closing, a well-known New York gentleman said he hoped nothing would be done to make the visitor's work seem that of the Association; the implication being that since the gentleman who had the work in charge was an honorary member of the Association, his work would be handicapped if it were thought that it was done at the instance of the said Association, or even with its approval. Surely this shows the feeling towards even the most useful and beneficial corporations with *quasi*-public functions—that men, well informed in matters of public opinion and policy, should fear lest so generally useful and beneficial a measure should be defeated if the Legislatures knew that the gas companies desired it.

It is true all this occurred previous to the Presidential Election; but it must not be assumed that things are changed for the better. It really has only prevented changes for the worse. What is needed is action by the Washington Government, making

all corporations creatures of the Government of the United States, and not of any one State; and subject to laws made by Congress, and not by State Legislatures. Of course, such a change would make an awful tempest in a teacup; but the result would be beneficial all along the line. It is to be hoped that it will be successfully attempted before long.

VITIATION OF AIR ON GAS-WORKS.

By R. Gordon Mackay, Assoc.M.Inst.C.E.

One of the most interesting visits which an engineer can pay—be he young, middle-aged, or old—is to a well-equipped and up-to-date gas-works, where can be seen the whole of the intricate and delicate machinery for the production of the 10,000 cubic feet of gas from each ton of coals brought to the works, and subjected to the dry distillation of the many settings in the retort-house. The whole of one's senses are agreeably affected—sight, sound, and smell, though in the latter category, perhaps, it would be savouring of more exactitude to write that the olfactory nerves are affected less by pleasurable emotions than by an acute sense of the presence of odours possibly hitherto unacquainted with.

It would seem, at first sight, that living among such never-intermittent distillation and almost continuous evolution of odoriferous whiffs, the atmosphere on the works would become decidedly unpleasant to those whose calling has brought them to reside day and night within its precincts. And yet it is not so; for managers of these works appear to be a particularly healthy class of men, and their subordinates—drivers, stokers, &c.—are usually very fine specimens indeed of physically developed and health-blessed humanity. It is evident that the very odours that are given off are a means of stamping out other impurities, and of dealing such a blow to the parasitic micro-organism that this ridiculously small though gigantically powerful germ will very seldom put in his appearance in the neighbourhood of the purifier and the space set apart for the natural revivification of spent oxide.

The more useful of these tiny germs are found to such an extent in coal that the retort-house may be justly claimed as a veritable slaughterhouse of bacteria. To these bacteria, daily cremated in their tens of millions, are due the very existence of coal which, under their action, has been transformed from the spores of vascular cryptogams or green *algae* according to the kind of coal in question. It is the dot-like organism known as *Micrococcus Carbo* which is the greatest sufferer; and he may be seen with his collectively large, but individually minute, family by making very thin sections of the coal, or preferably of the only partially silicified plant, and microscopically examining same. These are called, in the biological language, *saprophytic bacteria*, because they prey upon excreta and decaying matter, and not on living organisms like their evil contemporaries of the parasitic class.

A few years ago it was wrongly asserted that the health of those working in gas-works purifying-houses and revivification sheds must be injured by the presence of the gases and vapours given off when the purifiers were opened for the discharge of the spent oxide. But it is more than probable that, owing to the great dilution of the poisonous gases in the surrounding air, the operator does not receive any harm at all when the proper and necessary precautions are taken for this dilution.

There are, it is true, many gases harmful to the animal organs in the coal gas as it leaves the hydraulic main—notably, ammonia, hydrocyanogen, sulphuretted hydrogen, sulphur, carbonic oxide, and various sulphur and carbon compounds. Now, although the gas is drawn through dry lime and iron oxide purifiers, it is shown that, on opening the latter purifiers for purposes of emptying and recharging with revivified or new material, part of the gases which have been taken up by the absorbent material are expunged into the surrounding atmosphere.

Carbonic acid gas, or the dioxide of carbon, as the chemist prefers to call it, is absorbed by the slaked lime piled upon trays or sieves, as in the so-called dry-lime purifier. When opened for recharging with lime, it cannot be immediately approached, because of the slight emission of the dioxide which, even in small quantities, produces languor and depression, and in larger quantities complete atony of the brain functions. Ordinary country air contains about 0·0004 per cent. of impurities, generally classed as this carbon dioxide. So that, by allowing the surrounding air to play on the purifier, the evolved gas is quickly disseminated and diluted by the fresher atmosphere. On large gas-works, the spent lime is carried off in waggons running on rails—in appearance a dirty green. It is revivified by burning, and is then used again.

The gases absorbed by the oxide of iron purifiers may be partly given off when opened for withdrawing the charge. The sulphuretted hydrogen has changed into ferrous sulphide; and most of the hydrocyanogen will probably have converted a portion of the ferric oxide into fixed prussian blue. But, nevertheless, quantitative results show the presence of hydrocyanogen, ammonia, sulphuretted carbon, and carbon monoxide in the neighbouring vicinity. The traces of sulphuretted hydrogen are barely observable. The quantities as measured on a large gas-works some few years ago were—

Hydrocyanogen . . .	0·012 to 0·0066 part per 10,000.
Ammonia	0·004 to 0·0020 ,, ,,
Sulphuretted carbon .	0·003
Carbonic oxide . . .	3·800 to 0·6000 ,, ,,

The above tests were made over the purifier; but a further test of ammonia was made in the revivifying shed, when the trace was 0·041 part in 10,000 parts of air.

It appears strange that, although the oxide of iron purifier has been in existence for probably fifty years, no method seems to be adopted for preventing the periodical opening and withdrawing of the charge, simply for revivifying the oxide, and so, after about thirty exposures to the open air, saturating it with sulphur to the extent of 50 per cent. by weight. If the purifier were provided with an extra inlet and outlet, and a centrifugal fan were made to discharge a current of fresh air through it, the spent oxide might be rendered fit again and again—care being taken to prevent the oxide from caking. Thus, thirty or forty operations might be saved, and also the space required for purposes of revivification. Were this possible, a large amount of labour, and many disagreeable odours would be dispensed with; for although the gases giving rise to these odours are present in such small quantities, their presence even in such a manner is far from desirable. The writer finds that the application of a small centrifugal fan has been successful in some gas-works in revivifying the spent oxide three or four times; but the difficulty of preventing the material caking and swelling in the spaces of the grids seems insuperable.

In the manufacture of ammonium sulphate from ammoniacal liquor, there is scarcely any disagreeable odour given off; but then the gases produced by the combination of the sulphuric acid and the liquor are conveyed directly to a condenser, and afterwards are consumed in a furnace without occasioning either odour or inconvenience. Or if the sulphur is to be recovered, these noxious gases are carried through an oxide of iron purifier, when the poisonous vapours become absorbed.

It has sometimes happened that a works has eventually found itself well-nigh surrounded by inhabited tenements; and thus the question of dust prevention has been raised. It is then that the retort-house has to be specially arranged for, and a complete mechanical ventilation plant installed, in order to keep a current of fresh air passing continually through the house and drawing with it dust, smoke, and vitiated air which would otherwise escape and become a nuisance to the surrounding houses. The dust has to be then automatically checked and deposited, and only cleansed air allowed to leave the windows (or more rightly speaking outlets) of the retort-house. This precaution becomes a great boon to the neighbouring inhabitants, and might even be adopted merely for the sake of giving some ventilation to the retort-house, which would then be quite independent of any external or natural conditions.

In conclusion, the question of smoke prevention need scarcely be touched; for coke is burnt in the retort-furnaces, so there is not very much black smoke to be seen emerging from a retort-house chimney, and the boilers are generally well able to burn fuel of all sorts, owing to their extra large grates and specially fitted induced-draught steam-jet apparatus. The writer believes that the jet is more usually employed owing to engineers preferring to use this apparatus with its attendant enormous consumption of steam to the more economical application of a fan driven off the shafting or even by an independent steam-engine. But then steam is used for so many purposes that the saving of 100 lbs. per hour, or some such quantity, is scarcely worth the thought.

Spontaneous Combustion of Coal.—According to some inquiries into the causes of the spontaneous combustion of coal of which an account recently appeared in the "Journal für Gasbeleuchtung," out of twenty-nine conflagrations of which the causes were known, twelve were due to dampness, three to dusty coal, two to dusty and damp coal, one to the high percentage of sulphur, three to moisture and sulphur, one to Saar coal being placed upon Ruhr coal, two to ventilation-tubes, and five of the number to external heating.

Water Power to Produce Electrical Power.—We learn from the "Montreal Star" for the 3rd ult. that the first step in the direction of utilizing the immense power of the Ottawa River, for the purposes of producing electrical force for manufacturing purposes, was successfully inaugurated the previous Saturday, when the formal opening of the Capital Power Company's new power-house at Dechene took place. The plant consists of eleven turbines driving the electrical plant to produce 2508-horse power; two turbines driving plant leased to the Hull Electric Company, with a total of 332-horse power; and two turbines driving the mills rented to the Dechene Milling Company, totalling 173-horse power—being a grand total of 3015-horse power employed for the purpose.

The "Transactions" of the Gas Institute.—The volume of "Transactions" of the Gas Institute for the past year has been issued. It contains a report of the proceedings at the annual meeting—the thirty-seventh in the history of the Institute—held at the Royal United Service Institution in June, under the presidency of Mr. E. H. Stevenson, M.Inst.C.E., together with the summary of the proceedings at the International Gas Congress held in Paris in September which appeared in the "Journal" at the time. The book is rather more bulky than usual, owing to the large number of plates; six being required to illustrate Mr. Chester's paper on "Automatic Stoking and Inclined Retorts," and nine that of Mr. A. T. Walmisley on "Retort-House Roofs." There is also a plan of the Clichy station of the Paris Gas Company. The volume has been produced under the editorship of Mr. Walter T. Dunn, the Secretary of the Institute.

TECHNICAL RECORD.

THEORY OF THE WATER-GAS PROCESS.

By Drs. H. STRACHE and R. JAHODA, of Vienna.

[Abstract Translation of Articles published in the "Journal fur Gasbeleuchtung" last year.]

It is a recognized fact that carbon in a deep layer burns at high temperatures to carbonic oxide. Much astonishment therefore prevailed when Dellwik announced, in his patent specification, that, with a suitable pressure of the blast, and a correct depth of coke, he was able to burn it direct to carbonic acid. Moreover, the pressure of blast named—viz., 6 inches difference between the pressures below and above the bed of coke—was not so very much greater, nor was the depth of the bed so very much less, than had been previously tried without deviations from the earlier results being observed. Drs. Bunte and Leybold, and many other experts, publicly expressed surprise at the results reported to have been obtained with the Dellwik plant used at Warstein; but they admitted that they were satisfied that the products of combustion during the "blows" with the plant consisted essentially of carbonic acid. Professor Lunge had, indeed, deemed it necessary to advance a modification of the prevailing theoretical conception of the process of combustion in the gas-generator, in order, as he put it, to reconcile it with the incontrovertible fact that, by simply increasing the pressure of the blast, notwithstanding a deep bed of fuel, the formation of carbonic oxide could be avoided and the production of carbonic acid secured. He suggested that there might be a change in the point of dissociation of the carbonic acid, owing to higher velocity of the blast; but he was unable to formulate an actual theory of the phenomenon, as he had not the necessary data as to the velocity of the blast in other water-gas systems.

In order to elucidate the disagreement of earlier observations with the Dellwik claims, and a number of other points of the utmost importance to the water-gas industry—and especially the loss of heat in the water-gas process—an extended series of researches were undertaken, of which the results are given in this communication. Briefly, they show that, in the first place, the direct combustion of carbon to carbonic acid is attained, not by a high pressure of air-blast and small depth of fuel, but by adherence to a low temperature. The result is not novel, but is familiar to every engineer, who knows that, on lighting up any generator, as long as the charge of fuel has a low temperature, carbonic acid is produced; and carbonic oxide only after the temperature has risen. There is consequently nothing simpler—disregarding the pressure of the air-blast and the depth of fuel—than to interrupt the blow in a water-gas generator as soon as carbonic oxide appears in the effluent gases; and the tests made by Bunte, Leybold, Lunge, and Lewes, at Warstein, doubtless referred to such short blows. The natural objection to this idea is that the requisite temperature would not be attained in the generator for effecting complete decomposition of the steam; but this will be met in the second part of the authors' researches.

Bunte, indeed, has proved that the extent to which the steam is decomposed is chiefly affected by the temperature; but he did not have occasion to take account of the rate of flow of the steam.* These researches supplement Bunte's, and show that the decomposition of the steam is influenced not merely by the temperature, but to a considerable extent by the rate of its flow; and that by the relatively low temperatures which are attained with a "blow" of one to two minutes' duration, a tolerably complete decomposition of the steam occurs, provided the rate of flow is proportioned accordingly.

Investigation of the losses of heat has shown that, for all intermittent water-gas processes, they are as follows:—

1.—During the "blows": (*a*) The heat carried off by the hot spent gases, (*b*) incomplete combustion of the carbon or formation of carbonic oxide, and (*c*) unconsumed fuel carried away by the air-blast—*i.e.*, coal dust or highly carbonaceous blown ashes.
2.—During the "runs": (*a*) The heat carried off by the hot water gas, and (*b*) steam passing out undecomposed with the water gas, having however been heated to the temperature of the incandescent fuel.
3.—During both the "blows" and "runs": Heat radiated from the plant.

The losses by incomplete combustion (1, *b*) can be avoided or diminished either by burning the carbonic oxide which is obtained to carbonic acid in a regenerator, in which the heat thus liberated is employed to pre-heat the air for the blast or the steam, or by efforts to secure complete combustion to carbonic acid in the generator. The first method has been adopted by Strache; the second may be carried out by adopting the principles indicated above—viz., short blows (entailing low temperature) and low velocity of the current of steam. A high velocity of the air-blast and a low depth of fuel are not only superfluous but irrational, as they increase the loss by unconsumed dust carried away (1, *c*), especially when small fuel is used. The losses under the other headings (1, *a*; 2, *a*; 2, *b*; and 3) are to a great extent dependent on the temperature of the generator and regenerator. The lower the temperature in the apparatus, the lower do they become. The heat carried off by undecomposed steam is, however, greater when the quantity of steam passing through undecomposed is increased; and for this reason, technical men have hitherto, in making water gas, maintained as high a temperature as possible in the generator, as complete decomposition of the steam was thus achieved.

From the foregoing, it is evident that the losses of heat are diminished, and thence the yield of water gas increased, when the temperature within the apparatus is kept low, since thus complete decomposition of the steam can be secured by the adoption of a low velocity for the current of steam. On the other hand, it is irrational to adopt too low a velocity, because the radiation from the apparatus remains constant, and therefore comes more into account, the smaller the make of gas in a given time in a plant of given size. Too low a steam velocity naturally diminishes the make per hour. The rate of flow of the steam must consequently be proportioned to the heat of the generator at the time; and as this diminishes as the run proceeds, the rate of flow of the steam must be gradually diminished also. In order that the steam may be admitted exactly in correspondence with the temperature in the generator from time to time, means must be employed for obtaining a measure of the relation they bear to one another. For instance, an appliance for the measurement of the velocity of the current of steam and a pyrometer, or the first appliance and a similar one for measuring the velocity of the effluent gas (because one volume of steam completely decomposed gives two volumes of gas), or an apparatus for the continuous estimation of the steam in the effluent gas—such as an optical instrument, by which the amount of steam present is inferred from the length of the flame—must be used.

The maintenance of a low temperature in the generator, which is possible under Strache's system, effects a considerable diminution in the losses through the chimney gases, the hot water gas, and radiation, and thereby brings about an increased yield of water gas. Earlier communications showed that the yield of gas under Strache's process increased considerably with the size of the plant, because the loss by radiation was relatively less in a large apparatus. But in the process as now described, the maintenance of a low temperature greatly reduces the loss of heat by radiation; and nearly as good yields are obtained from small as from large plants. The make of gas is 36,500 to 54,700 cubic feet per ton, according to the description of fuel used.

The researches will be dealt with under two headings—viz., (1) Investigation of the Blow; (2) Investigation of the Run.

I.—THE BLOW.

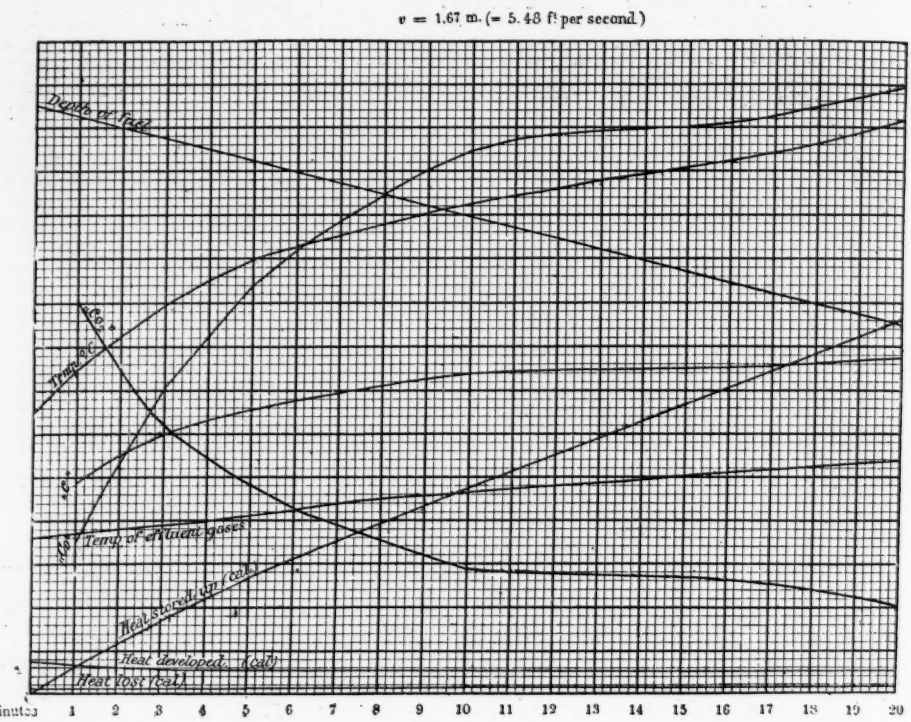
The heat changes which take place in the generator, considered apart from any regenerator, will first be dealt with. The investigations relate to the composition of the gases liberated from the coke during the blows, with different depths of fuel-bed and velocity of the blast, and to the temperature in the generator. An apparatus for determining the rate of flow of the air in the generator was necessary; and Krell's pneumometer appeared the most suitable. It consists of a disc set in the blast-pipe at right angles to its direction, and water-gauges to indicate the difference in the pressure on the two sides of the disc. The velocity in the blast-pipe, thus ascertained, is used to calculate the rate of flow of the air on the clear cross-section of the body of the generator, in metres per second. The rate was varied by altering the speed of the fan. This method of determining the rate of flow was more exact than a simple determination of the difference in the pressure at the bottom and at the top of the column of coke, because the depth of the fuel, the size of the lumps of fuel, and the temperature affect the rate, equally with the resistance offered by the column of coke. These factors do not interfere with measurements of the velocity in the blast-pipe.

It was also necessary to determine the heat of the generator. The sinking of the fuel in the generator interfered with the continuous use of a Le Chatelier pyrometer in the lower part of the vessel. An attempt to ascertain the temperature indirectly from the temperature of the effluent gases also failed, because it was found that their temperature increased with an increase in the velocity of the blast, and decreased with a decrease—doubtless because the surface of the coke in the generator, with a given difference of temperature between the gas and the coke, takes up a fixed quantity of heat in a given time. Hence, when the volume of gas is small, the gas is cooled by the coke to a greater degree than when it is large. Finally, therefore, it was found necessary to determine the heat of the generator from the heat supplied. For this it was requisite to know: (1) The quantity of carbon burnt per minute; (2) how much of it was burnt to carbonic acid, and how much to carbonic oxide; and (3) the temperature and the amount of the effluent gases, and thence the quantity of heat carried out of the generator.

The difference between the heat resulting from the combustion of the carbon and the heat of the effluent gases, with the amount of heat carried off, which can be calculated from the reading of an inserted pyrometer (as explained later), then constitutes the heat stored up per minute in the generator. The total of all this heat stored up in unit time represents the thermal state of the generator, if it is taken for granted that the content of the generator is always the same, and that the initial condition is identical in all the trials. In order to secure an initial state as nearly as possible the same in every case, all the trials were commenced after the generator had been at rest for a long time. The height of the bed

* See "JOURNAL," Vol. LXIII., p. 484.

Depth of Fuel. Ft. Ins.	Calories.	Temperature. °C.	C lbs.	CO, CO_2 %.
9 2	140,000	1400		28
8 6½	130,000	1300		26
			5·5	
7 10½	120,000	1200		24
7 2½	110,000	1100		22
6 6½	100,000	1000	4·4	20
5 11	90,000	900		18
5 3	80,000	800		16
			3·3	
4 7	70,000	700		14
3 11	60,000	600		12
3 3½	50,000	500	2·2	10
2 7½	40,000	400		8
1 11½	30,000	300		6
			1·1	
1 4	20,000	200		4
0 8	10,000	100		2


v = 1.67 m. (= 5.48 ft per second.)
Depths of Fuel.
CO_2 %
Temp. °C.
C.
Temp. of Ascend. gases
Heat stored up in Coke
Heat developed. (Calc.)
Heat lost (Calc.)
Minutes 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

of fuel, however, was one of the conditions the effect of alterations in which was one of the subjects to be investigated. Therefore the quantity of heat stored up must be estimated from the average temperature of the generator charge. This is calculated by dividing the stored-up amount of heat by the capacity for heat of the charge, &c. The capacity for heat comprises the capacity for heat of the charge of coke, which is dependent on the height of the bed of coke, and the capacity for heat of the walls of the generator, which is altogether independent of the height of the bed of coke.

The external radiation of the generator need not be considered, as the separate experiments on the blows only occupied ten to twenty minutes from incipient redness to a white heat; and in this time no considerable increase in temperature of the outer wall of the generator is possible. The capacity for heat of the coke in the generator can be calculated from its depth, specific gravity, and the specific heat of coke. The capacity for heat of the fire-brick lining of the generator cannot be similarly calculated, as the heat only penetrates partially through the lining; and therefore this value had to be found by experiment. The following was the method adopted in this and later researches: During a twenty minutes' blow, the percentage of carbonic acid in the escaping gas was determined at each minute, or at longer intervals. The samples of the gas were collected in a number of glass vessels, provided with cocks, connected with a pipe which passed through the top of the generator. There was always sufficient pressure in the generator to enable samples of the various gases to be taken thus.

In the above diagram, the curve marked "CO_2" shows the percentage of carbonic acid in the gas at each minute, when the rate of flow of the air of the blast is 1·67 metres (5·48 feet) per second. Free oxygen was never present; and consequently the percentage of carbonic oxide could be calculated, and is shown in the curve marked "CO." From the rate of flow, or the velocity, of the air of the blast, the amount of air blown in can be calculated; and from this and the percentages of carbonic acid and carbonic oxide, the quantity of carbon consumed per minute is ascertained, and is shown in the curve marked "C" [in pounds per minute]. This curve demonstrates that, with a constant blast, far less fuel is consumed in the early than in the later portion of the blow; while the heat developed is much greater at first than towards the end, as is shown by the curve marked "Heat developed," which is calculated from the percentages of carbonic acid and carbonic oxide, and the quantity of air blown in. The heat which remains within the generator is equal to that developed, less the heat carried off by the gas made. The latter, however, is not in simple proportion to the temperature of this gas, because the specific heat of carbonic acid is not constant, but increases considerably with the temperature. Blass's formula was used for the specific heat of carbonic acid. It is as follows:—

$$\text{Specific heat} = 0{\cdot}20 + \frac{t}{5660}$$

where t = the temperature in degrees Centigrade.

The curve for the heat lost naturally shows a continuous rise corresponding with the increase in temperature of the gas made. The heat stored up in the generator is found graphically from the area contained by the curves for the heat developed and the heat lost. It has been determined graphically, and is shown in the curve marked "Heat stored up." The temperature prevailing in the generator may be assumed at the end of a twenty minutes' blow to be approximately the same all over it, and was found by a Le Chatelier pyrometer to be 1320° C. (2408° Fahr.) in the twentieth minute, and to have become practically constant. The height of the bed of fuel was determined at the beginning and the end of the blow; and on the assumption that it falls uniformly, it is shown in the curve marked "Depth of fuel-bed." The diagram shows that this depth is 5 ft. 7 in., and the heat stored up 85,600 calories, at the end of the blow.

The temperature of the fuel, &c., contained in the generator is calculated by the formula—

$$\text{Temperature (°C.)} = \frac{W}{h\,c + K}$$

in which W = the heat stored up, h = the depth of the fuel-bed in decimetres, c = the capacity for heat of a layer 1 decimetre deep of the coke-charge, and K = the capacity for heat of the fire-brick lining of the generator. The capacity for heat of a decimetre layer of the coke is calculated from the expression $r^2\pi \times s \times S$, in which s = the weight of a litre of coke (in kilogrammes), and S = the specific heat of the coke. The value of this expression in the case of these researches was 2·34. The rise of temperature for the whole blow was 670° C.; therefore the constant K was calculated thus—

$$670 = \frac{85{,}600}{17{\cdot}0 \times 2{\cdot}34 + K} \therefore K = 87{\cdot}9$$

In all subsequent trials, the rise of temperature of the coke in the generator could be calculated from the stored-up heat, deduced as above, and the depth of the fuel-bed according to the formula—

$$t - t^{\circ} = \frac{W}{h \times 2{\cdot}34 + 87{\cdot}9}$$

The foregoing calculations also render it possible to find the efficiency at any moment during the blow. It is the quotient of the stored-up heat divided by the quantity of heat which would be developed if the whole of the carbon consumed were burnt completely to carbonic acid, and the whole of the heat were to remain in the generator.

(To be continued.)

COMPRESSED HYDROGEN FOR INCANDESCENT LIGHTING.

Dr. O. Schmidt propounded, at last year's meeting of the German Electrochemical Society in Zürich, a novel method of obtaining light in outlying places. He has patented a process for the electrolytic decomposition of water, whereby he obtains 168 litres of hydrogen, and 84 litres of oxygen (both of a high degree of purity) per kilowatt-hour expended. The electrolyte is soda solution, of which the proportion of carbonate continues fixed, and water is supplied in a slight stream to replace that which is decomposed.

He proposes to compress the hydrogen thus obtained, in steel cylinders, to 150 atmospheres pressure.

Among a number of uses for this compressed hydrogen, he names lighting by means of Welsbach mantles. The power expended on compression is said to amount to 5 per cent. of that required for the production of the hydrogen. Hence 1000 cubic feet of hydrogen, compressed to 150 atmospheres, are obtained by means of 177 kilowatt-hours, or 255-horse-power-hours. A cubic foot of hydrogen is stated to afford a light of about 12½ (English) candle-hours. Hence about 70 candle-hours are obtained per kilowatt-hour. This is said by Dr. Schmidt to be a considerably higher illuminating duty than is obtainable by expending the power on the production of calcium carbide, and using the acetylene generated therefrom for lighting. But the "Journal für Gasbeleuchtung" points out that actually about 70 candle-hours are likewise obtainable per kilowatt-hour through the medium of carbide and acetylene.

Dr. Schmidt considered that hydrogen could compete with acetylene for distances up to about 400 miles; but certainly this allowance is too great. On the other hand, at and near the source of power, electric lighting is far cheaper than either hydrogen or acetylene; for over 290 candle-hours can be obtained by incandescent lamps per kilowatt-hour. Thus very near the source of power the hydrogen could not compete with electric lighting; and at a considerable distance, it could not compete with acetylene. Under certain local conditions, it might conceivably be cheaper than either in an intermediate zone. It has the advantage of yielding no carbonic acid on combustion and relatively little heat, so that hygienically it has much to recommend it. It is, of course, only intended to be applied for the production of small sources of light.

EFFECT OF INCANDESCENT GASLIGHT ON PLANT GROWTH.

It will doubtless be in the recollection of many of our readers that some twenty years ago the late Sir William Siemens made a series of experiments on the influence of the electric light upon vegetation. Similar experiments with incandescent gas were described by Mr. J. J. Willis in a recent number of the "Gardeners' Chronicle." They were carried on by Mr. L. C. Corbett in a greenhouse at the West Virginia station, during the years 1895 to 1899, with lettuce, radishes, spinach, tomatoes, sugar-beets, and seedling cabbage, mainly from an economic standpoint. Eight Welsbach incandescent burners were used, and they were so alternated in position from time to time as to overcome local temperature and differences of light.

The experiments with lettuce involved twelve distinct crops and nearly 10,000 plants. Transplanting the young plants from pots, and using an artificial light only during the period the plant occupied the permanent greenhouse bench, were adopted after comparative trials as being the best method for the growing of lettuce on a commercial scale. The plants grown in artificial light were taller, heavier, grew faster, and matured more quickly than those grown from the same lot of seed under normal conditions. In one experiment, 400 plants exposed to the stimulating influences of the artificial light for 46 nights weighed 68½ lbs.; while a similar lot grown under normal conditions weighed 49½ lbs.—an increase in favour of the former of 38¾ per cent. Radishes were grown between the rows of lettuce. The artificial light notably increased the development of the tops of the radishes, and slightly increased the size of the roots. The heliotropic effect of the incandescent light was greater with radishes than with any of the other plants grown. The stimulating influence of the light, on the other hand, was greatest with spinach. It caused the production of seed shoots in the row to a distance of nearly 8 feet from the light. Spinach plants subject to the influence of the light grew faster, and completed their growth in less time, than plants grown normally. The records of the yield, and the date of first bloom of tomatoes grown from seed and also from cuttings, show no increase in weight of the fruit grown in the light, though the blossoming period was from 8 to 18 days earlier, and the individual fruits were generally larger than when grown under normal conditions. With sugar-beets, the tops, sugar-content of the roots, and percentage of purity were considerably increased by the use of the incandescent light. The largest and heaviest roots, however, were grown under normal conditions.

The range of stimulating influence of the incandescent light was somewhat variable for different crops. In general, the maximum growth was attained at from 12 to 16 feet from the light; while a perceptible increase was noticed at 24 feet. The stimulating influence of the light, as indicated by the growth of plants used in the various tests, is shown by the order in which the sorts are named; the first being the most susceptible: Spinach, cabbage, radish, lettuce, tomatoes. In a study of the periodicity of plant growth as modified by the influence of the artificial light, it was found that the most active period of growth of lettuce subject to the influence of the incandescent gaslight began at 11 p.m., and continued until 9 a.m.; while with the plants grown under normal conditions the most active period began at 4 a.m., and continued until 11 a.m. In the first instance, the period of growth was ten hours; and in the second, seven hours. It is reported that no injurious effects resulted from the use of incandescent gaslight in these experiments.

ANCIENT WATER-WORKS.

In the "JOURNAL" for the 13th of November, we gave some extracts from the Inaugural Address delivered by Mr. James Mansergh at the opening of the current session of the Institution of Civil Engineers. One section of the address was devoted to an interesting description of ancient water-works, particularly those of Rome. Want of space did not permit of this being given in our columns at the time; but we are now able to reproduce it. In his introductory remarks, Mr. Mansergh explained that his early training had been mainly upon water and sewerage works, and that he had been engaged almost exclusively in this department of his profession since 1866. Until the advent of modern electrical engineering, he had regarded the work of a hydraulic engineer as the most interesting, as it was probably the most ancient, branch of their practice; one of his predecessors having built a dam of hewn stone at Kosheish, to divert the course of the Nile from the spot upon which Mezza desired to build Memphis nearly 5800 years ago. He then proceeded to describe some early water-works.

In Egypt a canal was made by order of Usertesen III., by which he sailed southward to crush Ethiopia 2660 years B.C. In Babylonia, 2350 B.C., Siniddinam, the King of Larsa, enlarged the canal—a still more ancient work—on which the town was situated; while Rimsin, King of Elam, provided an outlet for the Tigris (River of the Gods) into the Persian Gulf about the same time. Khammurabi, the King of Babylon, about 2320 B.C., having witnessed the ravages of floods in the Lower Tigris, organized with gratifying results a system of improvement in the complicated network of ditches and channels which intersected the territory belonging to the great cities between Babylon and the sea. In India, efforts were made in very early times to preserve and utilize the rains and rivers; and in Beluchistan the great cyclopean dams of stone known as the Ghorbasta were erected, it is believed, about 1800 B.C., or 3700 years ago.

In Egypt, irrigation works can be traced back to a very remote period. In that comparatively level country an extensive system of artificial ponds, reservoirs, or lakes, with a network of distributing canals, was in existence at least as early as the time of Sesostris, otherwise Rameses II., about 1388-22 B.C. If the art of irrigation was taught to the ancient Egyptians by the natural overflowing of the Nile, it is probable that Egypt in her turn afforded an example to Assyria and Babylon, to Carthage and Phœnicia, and also to Greece and Italy. In Persia, there is evidence that the hydraulic engineer had carried out irrigation works from 700 to 600 B.C. In Greece, Athens was supplied about 520 B.C. with water from an ancient spring called Callirhoe, flowing from the foot of a broad ridge of rocks which crosses the bed of the Iliasus. In Ceylon, it is believed, the first tank for irrigation purposes was built by Pandinousa, the second of the Hindu kings, in the neighbourhood of his capital, Anuradhapoore, about 504 B.C. In India, it appears on the testimony of the Greek writer Megasthenes, who lived about 300 B.C., that irrigation was certainly practised before his time. Coming down into the Christian era, the aqueduct of Merida in Spain was erected about 10 A.D.; that of Segovia, about 105 A.D.; and the new water supply for Olympia was introduced by Herodus Atticas about 157 A.D.

In the early seventies, I had a commission to examine and report upon the Claudian aqueduct, by which water was supplied to Naples 1800 or 1900 years ago from the Orciuoli springs in the Sabato Valley, between Serino and Avellino. At the time of my visit, the river bed was practically dry from Orciuoli upwards towards Serino; and it was most interesting to see how the welling out of the ground of these magnificent springs went to produce in a few chains a stream of probably 15 to 20 million gallons a day. I found the remains of the Claudian aqueduct in several places both below and above ground. I had great difficulty in obtaining permission to examine the former; and it was only through the authority of the local Syndic, under pressure from a member of the Italian Parliament who accompanied me, that I obtained a guide to one of the shafts. This man protested piteously against the removal of the shaft covering, and crossed himself vigorously when I took steps to ascertain the depth to the conduit. I got out a scheme to utilize these springs on modern lines, and made an estimate of the cost; but nothing further came of it at the time. Some ten years later, however, the work was taken in hand; and now Naples is supplied from the source utilized in the time of Claudius.

In refreshing my memory about early water-works, I have been pleased to find the history of nine of the aqueducts of Rome as told by Sextus Julius Frontinus, Water Commissioner of the city, in the second half of the first century of the Christian Era; and I propose to go into some detail about them, at the risk of re-telling to some a story with which you are already well acquainted. This work of Frontinus has become accessible to English readers through the enterprise of Mr. Clemens Herschel, an American engineer, who has published a photographic reproduction of the original Latin manuscript preserved in the monastery of Montecassino, about half-way between Rome and Naples, and its reprint in modern Latin; also a translation into English and some explanatory chapters.

From the foundation of Rome in 754 B.C., for 441 years—that is, to 313 B.C.—the citizens were content with using water which they drew from the Tiber or from wells or springs. But in that year the Appian water was brought into the city by the censor Appius Claudius Crassus, who also had charge of the construction

of the Appian Way from Porta Capina to the city of Capua. He had for his colleague Plautius, who received the name of Venox (the searcher of springs) on account of his search for the springs of this water. Appius appears, however, to have been the smarter of the two; for while Plautius was induced to resign his office before the expiration of his normal term, Appius contrived to extend his until he had not only completed the aqueduct but also the highway. Hence he enjoyed the honour of giving his name to Rome's first aqueduct.

The water which this conduit brought into the city was derived from springs situated about half a mile along a cross road leaving the Prenestine Way between the seventh and eighth milestones from Rome. Beginning at the springs, and entering the city at the Porta Trigemina, its length was about 10·6 miles, of which all but 300 feet was laid underground; the remainder being on a masonry substructure above ground or on arches. Its cross section was 5 feet high by 2 ft. 6 in. wide, and probably rectangular. It delivered water at a comparatively low level—*i.e.*, about 55 feet above the sea in the city; but its height at the springs Frontinus does not state, nor have I been able to ascertain it from any other source.

The second of Rome's aqueducts was a more ambitious, much longer, and consequently much costlier, undertaking than the Appia. In the year 273 B.C., the censor Manius Curius Dentatus contracted to have the waters of the River Anio, rising in the Apennines, brought into the city for the sum realized by the sale of the spoils taken from Pyrrhus. Two years later, Curius and Fulvius Flaccus were elected Water Commissioners; but Curius died five days after, and Fulvius finished the work. This aqueduct —the Anio Vetus—had its intake from the river up-stream from Tibur at the twentieth milestone outside the Baranean Gate; and early on its course a branch was taken off to supply Tivoli.

Above the point of abstraction, the River Anio has a length of about 21 miles, and a drainage area approximating to 151 square miles. There is no record showing that any subsiding reservoir was constructed at the intake. The aqueduct had a length of 40·7 miles, mainly underground, there being only 1100 feet above ground on a masonry substructure, and apparently no arches. The cross section of the conduit was 8 ft. high by 3 ft. 8 in. wide; but we have no authentic record of the fall between the two termini, nor how the fall was distributed throughout the length. In 145 B.C., when the Appia and Anio Vetus had become leaky by reason of age, and water had been diverted from them by unlawful takings, the Senate commissioned Marcius—who at that time administered the law as Prætor—to restore these aqueducts to usefulness, and to protect them; and because the growth of the city seemed to demand an increased supply, he was also empowered to investigate whether he could bring other additional waters into the city. He seems to have made a report on the subject recommending a source near to the thirty-eighth milestone on the Sublascensian Way, "where numberless springs gush forth from caves in the rocks immovable like unto a pool, and of a deep green hue."

Before, however, instructions were given to carry out the work, a discussion arose among the Council of Ten, who, consulting the Sibylline Books for another purpose, found that it was not right for the Marcian waters, and still less for those of the Anio, to be brought to the Capitol. It was a little late in the day to make this latter discovery, because the Anio water had been used in the city at that date for more than 160 years. The matter was then discussed in the Senate, and revived three years later; but ultimately the popularity of Marcius Rex carried the day, and it was decided to utilize these beautiful springs.

Fenestella says that 180 million *sestertii* were appropriated for the works of the Marcian aqueduct—equal, if the basis of calculation is correct, to upwards of £1,600,000. This sounds like a big estimate for such a work in those days; and possibly there is some mistake. Its length was about 58·4 miles, of which 51·3 miles were below ground (what we should now call "cut and cover" work contouring the hill sides), 0·5 of a mile on a substructure of masonry above ground, and 6·6 miles on arches. It would have been intensely interesting to have seen a longitudinal section of this or any other of the ancient aqueducts, and the instruments with which the engineers did their levelling so as to maintain the gradients of their conduits. The cross section of Marcia was 5 ft. 8 in. high and 3 ft. 6 in. wide; and it delivered water in Rome at an elevation of 201 feet above sea-level.

Thirty years ago the use of the water from the Marcian springs was resumed in Rome under a concession granted to an English company by Pope Pius IX.; and the name given to the modern aqueduct is "Acqua Pia." The engineer who has the honour of effecting this revival is Colonel Bernard Blumenstihl, who, in his little book entitled "Brevi Notizie sull' Acqua Pia (Antica Marcia), 1872," gives a full account of his search for, and discovery of, the ancient Marcian springs. He says that these springs are now called the second and third "Serena" situated on the north side of the Anio, a short distance down stream from Agosta. He has found the ancient masonry conduit leading the water from the springs towards Rome.

In the year 127 B.C.—that is, 18 years after the Marcia—the Tepula aqueduct was constructed by the censors Servilius Coepio and Cassius Longinus. The source of the water utilized by this aqueduct was certain volcanic springs situated nearly 2 miles to the right of the Latin Way as one comes from Rome, and near the tenth milestone, on the slopes of Mount Albani. This is about half way between Frascati and Rocca di Papa. It will be noticed that the first and third Roman aqueducts received the names of the men chiefly responsible for their construction—viz., Appius and Marcius. In this case the name Tepula was adopted on account of the slightly warm or tepid character of the water of the springs (63° Fahr.), which are now called Sorgenti dell' Acqua Preziosa, on account possibly of their possessing some curative properties.

Up to the time of the building of the Tepula conduit, these structures had been made principally of dimension masonry; but in this one concrete was almost exclusively used. What the exact length of Tepula was I cannot make out, but it was probably a mile or two less than Julia, which was made next; and of its whole length nearly half must have been on arches. Its cross-section was about 3 ft. 4 in. high by 2 ft. 8 in. wide, and it delivered water to the city a few feet higher than Marcia, or probably about 208 or 210 feet above sea-level.

In the year 35 B.C., Agrippa, when he was Ædile, appropriated certain springs in the neighbourhood of the Tepula, but farther up towards Rocca di Papa; these springs—the Julia—having three times the volume of Tepula, and yielding water of 13° lower temperature. The Tepula was taken into the city for 93 years, after which time—viz., in 33 B.C.—Agrippa brought the water by a branch conduit from the Julia springs into the Tepula aqueduct, and thus produced a mixture which, having regard to the relative volumes, had a temperature of probably 53° or 54°. This water flowed in one and the same channel for 4 miles, and was then divided into two, and went on by the old Tepula and the New Julia conduits, and entered the city near the present Porta Maggiore; Tepula being in the middle, and sandwiched vertically between Marcia below and Julia above. The Julia conduit was 4 ft. 7 in. high and 2 ft. 4 in. wide; its total length was 14·6 miles, of which half a mile was above ground on a concrete base, 6·13 miles on arches, and the rest below ground.

In 33 B.C., Agrippa rebuilt the nearly ruined aqueducts of Appia (280 years old), Anio (240 years old), and Marcia (112 years old), and furnished the city with a large number of ornamental fountains. He also, thirteen years later, took in hand the utilization of other springs found on the estate of Lucullus in the valley of the Anio, and only a short distance up-stream from the Appia springs. The story goes that these springs were pointed out to the soldiers who were searching for water by a young girl of the district, and that, on opening out the ground all round, a great quantity was discovered—justifying the making of still another aqueduct, to which was very appropriately given the name of Virgo. A little temple was erected near the intake, and in it a picture was placed representing the incident. The source was on the Collatian Way, near the eighth milestone. The cross section of the conduit was 6 ft. 7 in. high by 1 ft. 7 in. wide, and its length 13·35 miles, of which 12·18 miles were underground, 0·51 mile on a masonry base, and 0·66 mile on arches. This was a low-level supply delivering the water into Rome only 67 feet above sea-level.

It would appear from the foregoing records that in the time of Agrippa, shortly before the commencement of the Christian era, the city of Rome must have been magnificently furnished with water, for Agrippa had restored Appia, Anio Vetus, and Marcia, and Tepula was probably in good working condition. He had also constructed Julia and Virgo; so that the whole six aqueducts —five carrying spring water and one that of the River Anio— were all contributing to the supply. What the quantity delivered into the city daily actually was, must necessarily be a matter of the vaguest conjecture; for, first, we have no data as to the yield of each source; secondly, we know nothing of the ruling fall in any of the aqueducts, so cannot estimate their discharging capacity; thirdly, we have no information as to the quantity legitimately disposed of *en route;* fourthly, we cannot tell how much was surreptitiously abstracted by unauthorized or "winked at" tappings of the conduits; and fifthly, we do not know the amount of leakage through structural defects.

Of the seventh aqueduct bringing water to Rome (known as the Alsietina), Frontinus has nothing but adverse criticism; and he wonders how so exceedingly cautious a ruler as Augustus could have taken the trouble to supply a water which was so unwholesome that it could not be used at all for domestic purposes. The only excuses he can make for the projector were, first, that he had undertaken to establish a "Naumachia" (a sort of glorified Earl's Court marine circus), and wanted to avoid wasting good water to fill it; and, secondly, that this water, coming in as it did on the opposite side of the Tiber to that where all the other aqueducts delivered, could be used at times when no water could be procured from that side, owing to repairs of the bridges. The source of this supply was the Alsietinian Lake near a cross road, 6·16 miles from the Claudian Way at the fourteenth milestone. The aqueduct was 21 miles in length; 19·71 miles being underground, and 0·34 mile on arches. The water was delivered in the city at only 55 feet above sea-level, so that there was a fall of 625 feet in the aqueduct, for the altitude of Lake Alsietina is 680 feet. Augustus, however, did a small but useful work by building a conduit about ¾ mile in length, bringing in water to supplement the Marcian springs in time of drought; and to this conduit he gave the name "Augusta."

After this, and because the seven aqueducts were not sufficient to meet either the public needs or the demands of private luxury, Tiberius began, in the second year of his reign, 36 A.D.), the construction of two aqueducts—one taking water from the Cerulian and Curtian springs, and the other from the River Anio. These

works were completed in the most splendid manner by Claudius fourteen years later—that is, in 50 A.D.—the former being named after himself, "Claudia," and the latter "Anio Novus." The Claudian springs rise about 500 yards to the left of the Sublascensian Way, near the thirty-eighth milestone; and, in addition to the two above mentioned, the water from a very pure spring called Albudinum was taken into the Claudian conduit. This aqueduct had a cross section 6 ft. 7 in. high and 3 ft. 4 in. wide, and its length was 43·9 miles, of which 34·3 miles were underground, 0·58 mile above ground on a masonry base, and 9·06 miles upon arches. The water was delivered at the Porta Maggiore at 230 feet above sea-level. Claudia followed very nearly the course of Marcia; but some 36 years after completion it was shortened by driving a tunnel about 3 miles long under Mount Affliano, not far from San Gregorio. This tunnel was undertaken by a contractor named Pasquedius Festus; and it must have been a difficult work indeed when even black powder for blasting purposes was unknown.

Just 359 years after the Anio Vetus was built—that is in 86 A.D. —the River Anio was again tapped at a point near the forty-second milestone on the Sublascensian Way in the Simbruinum. This intake is 5 miles above that of the old Anio, and consequently at a higher level; and the drainage area above it is about 87 square miles. Here the river runs through rich cultivated lands, and has loose banks, so that the water was normally muddy and discoloured (like the Medway about Tonbridge), and much worse, of course, after rain. To take out this suspended matter, a settling reservoir was constructed below the intake. But this was evidently of insufficient capacity; and, being unaided by any process of filtration, the water was delivered in a discoloured condition into the city in times of rain.

The Herculaneum Brook, which has its source also near the Sublascensian Way at the thirty-eighth milestone opposite the springs of Claudia, was tapped and taken into the Anio Novus. This was a clear stream, but its contribution was not of sufficient volume to materially improve the quality or the appearance of the Anio water. The cross section of this aqueduct was 9 feet high by 3 ft. 4 in. wide. Its length was 55·6 miles, of which 46·7 miles was below ground, a length of 2·18 miles in its upper reaches was on masonry foundations above ground or arches, and nearer the city 0·58 mile on masonry, and 6·14 miles upon arches. Some of these were the highest of all the aqueducts; rising as they do to 109 feet above the ground.

After Frontinus's time, two other aqueducts were made—viz., the Trajana, taking its water from springs near Lake Bracciano, N.W. of Rome, and the Alexandrina (also called Hadriana), built by Severus Alexander in 226 A.D., and utilizing springs near the Via Prenestina. All these aqueduct waters were very hard.

There do not appear to have been at the city termini of the aqueducts any large service reservoirs containing from one day to six days' supply of the quantity of water dischargeable by each aqueduct, as would be the case nowadays, but merely small tanks (*piscinæ*), from which pipes of lead or earthenware fortified with concrete were taken off to provide water to separate private consumers, baths, fountains, &c. All the aqueducts bringing in water from the east appear to have crossed the north-east side of the city towards the Diocletian baths—that is, to the neighbourhood of the present Central Railway Station.

We have been accustomed to hear of the enormous volumes of water brought into Rome by the aqueducts which existed about the beginning of our era, and described by Frontinus; and I have always thought that there must be some exaggeration about the figures. In those days it is clear the full volume of water was not gauged either at the intake or the delivery end of the aqueducts, and no one seems to have understood the methods of calculating the quantity from the slope and sectional area. The estimations made by Frontinus were based on the discharge of a number of ajutages or apertures of various sizes; and he did not appreciate the difference between the discharge of (say) 100 separate 1-inch apertures, and that of one aperture whose sectional area was the sum of the aggregated 100. His standard ajutage, or unit of measurement for water in motion, was a *quinaria*, or circular aperture 0·632 of an English square inch.

Mr. Herschel claims to have discovered that Prony was at the bottom of the erroneous estimations of the total quantity delivered; as in the "Mémoires de l'Académie Royale, A.D. 1817," Prony says: "*If* we assume that the head acting on the *quinaria* was equal to its length—this being the custom in Rome in 1810 with respect to the '*oncia Romana*'—and *if* we assume a discharge freely into the air, the value of the *quinaria* will be so many gallons per 24 hours." Every writer since then, except Blumenstihl and Belgrand, has ignored the two *ifs* of Prony, and then, using his conjecture as a fact, and otherwise exaggerating quantities, has stated the consumption in Rome to have been about 312 million gallons in 24 hours.

These figures are absurd, for they would necessitate velocities in the aqueducts which could not possibly exist; and, after a painstaking study of all the conditions of the sources, conduits, and distributing appliances, Herschel finally comes to the conclusion that instead of the 312 million gallons, a more likely quantity to be carried daily by the nine aqueducts of which Frontinus had charge was about 70 million gallons—25 millions being lost or utilized *en route*, and 45 millions delivered into the city.

But we know, both from Frontinus and Pliny, that the nine aqueducts were seldom all in working order; two or three generally being out of use for repair. For this fact it will be right to make a still further deduction, probably to 32 million gallons, or, on the assumed population of that date of a million, 32 gallons per head per day. This may not seem a very large quantity, considering the great volumes undoubtedly used for baths and fountains; but, on the other hand, we must remember that for purely domestic purposes the greater part of the people used only such water as was carried to their homes in jars on the heads of slave and other women, and that many local sources were also available.

REGISTER OF PATENTS.

Prepayment Gas-Meters.—Frank Wright's Prepayment Gas-Meter Corporation, Limited, and J. D. Forster, of Peckham. No. 23,485; Nov. 24, 1899.

This invention (an improvement on patent No. 28,155 of 1896) is designed to obviate the disadvantage, found in practice, that when a bent or battered coin was inserted into the meter-receiver, the mechanism was liable to become blocked or to allow gas to be supplied without ejecting the coin when its equivalent of gas had been passed.

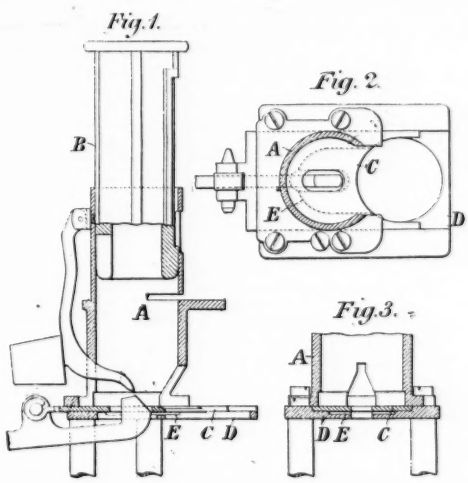
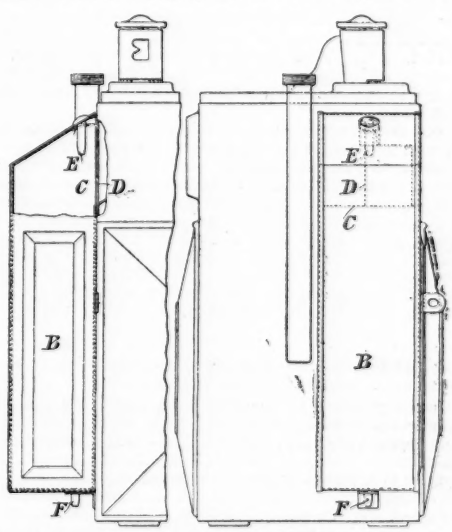


Fig. 1 is a sectional elevation of a coin-receiver for prepayment gas-meters of the kind described in the patent of 1896, and having the present improvements applied thereto. Fig. 2 is a horizontal section. Fig. 3 is a vertical section taken through the coin-receiver and slide. A is the receiver for the coins; B, the plunger; and C, the slide—all of ordinary construction, with the exception that the receiver is slightly recessed or enlarged in diameter at its lower end. D is the guide-plate upon which the slide reciprocates; the guide-plate being recessed immediately below the plunger, as shown at E.

With this construction, should a battered coin be inserted into the receiver and forced down by the plunger, when it reaches the lower end of the receiver it is free in the enlarged portion; and when a coin is bent or cupped, it falls into the recessed portion of the guide-plate so that, when the slide is moved forward by the meter mechanism in the usual way, the forward end of the slide does not pass under the edge of the coin, but owing to its being located in the recessed portion of the guide it catches the edge of the coin and pushes it forward.

Prepayment Gas-Meters.—Frank Wright's Prepayment Gas-Meter Corporation, Limited, and J. D. Forster, of Peckham. No. 23,486; Nov. 24, 1899.

The patentees claim the employment of a coin-receptacle—comprising



a single external elongated box, having a coin-inlet at its upper end, pins at its upper and lower ends, adapted to enter eyes upon the meter

casing, and means for locking it to the meter-casing—constructed as shown by the views of a meter taken at right angles to each other. B is the single box forming the coin-receptacle, of a length extending practically to the bottom of the meter, so as to provide space for the storage of such a number of coins as will obviate the necessity of frequently removing the box for collection. C is the orifice formed at the upper part of the box; and D is the orifice made in the meter-casing. These two orifices are so placed that, when the coin-receptacle is fitted to the meter, they form a passage through which the coins are discharged from the coin-freed mechanism into the box. E and F are pins engaging the eyes upon the meter-casing, so as to attach the box to the meter.

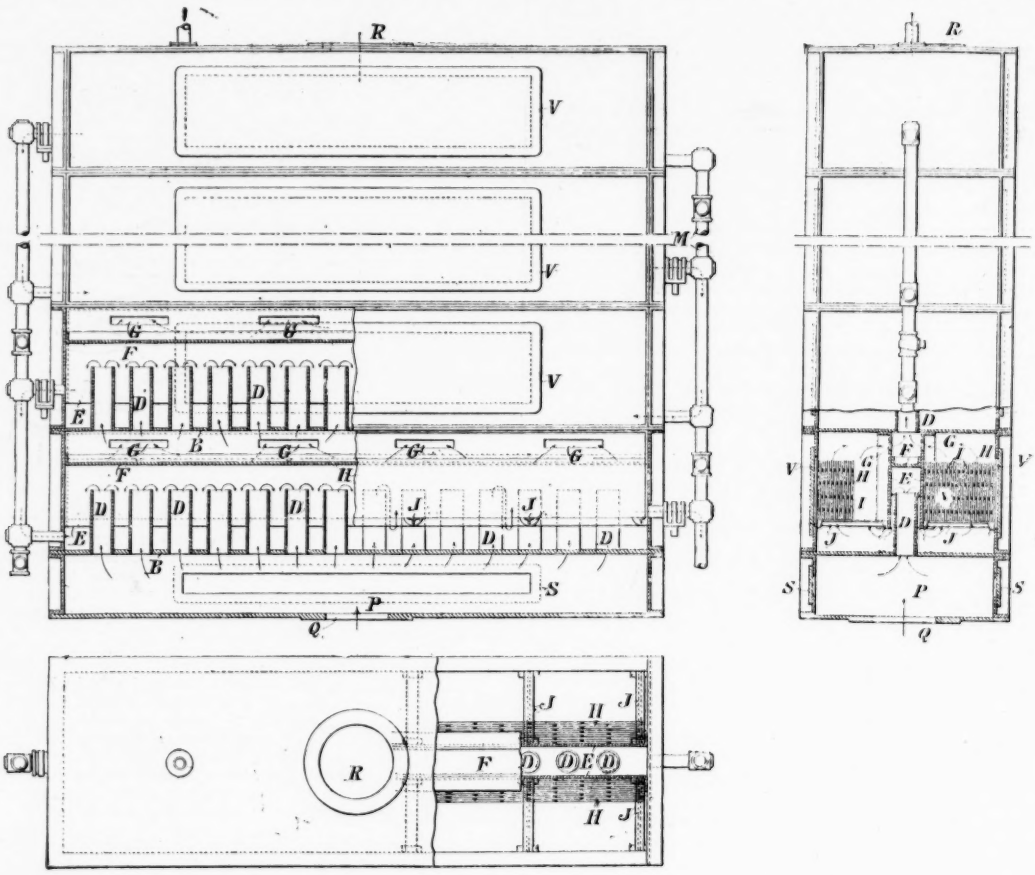
The box and meter are also formed with eyes which, when the box is fitted to the meter, enable a padlock to securely fix the box in place.

Washing and Scrubbing Gas.—Chandler, S., jun., & J., and Kirkham, Hulett, and Chandler, Limited. No. 24,383; Dec. 7, 1899.

This invention is especially adapted for works where there is no motive power which can be conveniently utilized for operating an apparatus which requires to be kept in motion. The pressure of the gas is utilized for keeping the plates wet; and a suitable casing is formed with a series of chambers, each of which is adapted to hold a certain quantity of water or liquor; while circulating-pipes are provided for allowing the water to gravitate from one chamber to another, and for flushing out the chambers when required. The gas to be washed is preferably introduced into the chamber at the lowest level, from which it passes successively through the other chambers to a suitable outlet.

The illustration shows a sectional elevation of the apparatus, a sectional plan, and a sectional end elevation.

The apparatus (preferably formed of flanged cast-iron plates) is provided with a series of horizontal partitions, which divide it into a series of superposed chambers. D are a series of pipes screwed into each partition, and through which the gas passes from one chamber to another; while E and F are longitudinal plates which form a cap over the pipes D. They are jointed together so that the gas which passes up through the pipes D is compelled to pass downwards beneath the plates E, which, when the apparatus is in operation, dip more or less into water contained by each chamber. In the plates E above the plate F are apertures G, through which the gas passes to the pipes D of the chamber next above. H are plates (of metal or other suitable material) arranged vertically between the plates E and the walls of the apparatus, and maintained apart by distance-pieces. The plates are supported upon cross-bars J, carried in brackets upon the walls of the apparatus and the plates E. The gas as it rises up through the water, and passes between the plates, this causes the water to bubble up or rise more or less between the plates H, and so maintain them in a wet condition. After the gas has passed through one chamber, it enters the next superposed chamber, and is again subjected to a similar washing process; and so on, according to the number of chambers employed in the apparatus.



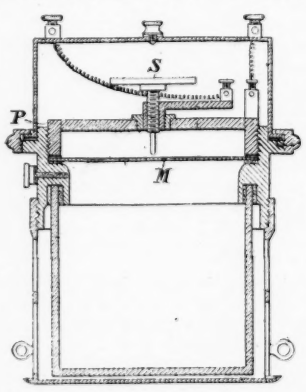
The pipes are shown through which the washing liquid gravitates from one tank to the other; fresh water being introduced at the top of the apparatus, and flowing into the next chamber below, whence it passes into the chamber beneath it, and so on. P is a chamber under the washing-chambers into which the gas is first admitted through the aperture Q, and which allows the gas to distribute itself over all the pipes D, and R is the aperture through which the gas escapes after being washed. S are covers for affording access to the chamber P; and there are like covers over openings V in the sides of the chambers, of sufficient size to permit of the introduction or removal of the bundles of plates H into and from the apparatus.

Producing Illuminating and Heating Gas.—Boehndel, H. H., of Kennington, S.E. No. 23,572; Nov. 25, 1899.

The patentee proposes to manufacture a highly absorbent body, by mixing absorbent materials—such as chalk, lime, powdered pumice-stone, peat moss, kieselguhr, and the like—with a substance (such as magnesia-oxide or silicate of soda) causing the absorbent materials to hold together in a porous mass; and the mixture is then, by the addition of water, formed into a paste, which, when divided into small pieces, is dried and afterwards calcined. The production of combustible gas is effected by passing a blast of air through a sealed vessel containing the highly absorbent material impregnated with any suitable hydrocarbon.

Indicating the Presence of Coal and other Gases in the Atmosphere.—Lyncker, G.A., and Mohr, M.L.F., of Munich. No. 2094; Feb. 1, 1900.

This is an automatic indicator of the presence and accumulation of methane, coal gas, hydrogen (pure or mixed), or any gas the specific weight of which is not above 0·6 (atmospheric air being = 1). The construction of the apparatus is founded upon the diffusibility of gases—that is, upon the fact that, when two kinds of gas are separated from each other by a thin porous substance (in the present case unglazed burnt clay), diffusion of the gases through the porous partition takes places, in the course of which the specifically lighter gas passes through the partition more quickly than the specifically heavier or denser gas. Consequently, when this process takes place in an enclosed space, an increase of gas pressure (greater or less according to the volume of diffusion) must result, and can be made to indicate itself by suitable means.



With the apparatus shown in the engraving, indications in connection with illuminating gas, hydrogen, and methane (fire-damp) have been established by several tests. With 1 per cent. (by volume) of methane, the apparatus acts in 10 seconds, with 1 per cent. of illuminating gas in 8 seconds, with 0·6 per cent. of hydrogen gas in 6 seconds.

The apparatus consists of a porous cylinder closed at the bottom. It is made of clay or the like, and is closed gas-tight by means of a corresponding thin metal-foil membrane M, conductively connected by a metal ring P with the terminal of an electric battery; a second terminal being conductively connected with the contact-screw S screwed into the bar of the ring, and insulated from the latter. The contact-screw, with its platinum point, is capable of adjustment above the centre of the membrane, in order that the sensibility of the apparatus may be varied according to the various conditions and kinds of gas likely to be met.

APPLICATIONS FOR LETTERS PATENT.

23,027.—Carpenter, C., "Incandescent gas-burners." Dec. 17.
23,044.—Naef, P., "Recovering products from fuel." Dec. 17.
23,075.—Hill, J., "Globes and chimneys." Dec. 18.
23,116.—Chandler, S., jun., & J., "Gas scrubbers and washers." Dec. 18.
23,132-3.—Scott Snell, C., "Incandescent gas-burners." Dec. 18.
23,136.—Dennstedt, M. E. H., "Desulphuration of illuminating gas." Dec. 18.
23,222.—Thompson, W. P., "Incandescent gas-lamps." A communication from the firm of Samuel Zielenziger. Dec. 19.
23 248.—Cowan, W., "Prepayment gas-meters." Dec. 19.
23,251.—Scholl, A., "Gas-compressing apparatus." Dec. 19.
23,275.—Hamilton, J. H., "Internal combustion engines." Dec. 20.
23,344.—Bole, W. A., "Internal combustion engines." Dec. 20.
23,402.—Adams, W. L., and Davey, E. M., "Internal combustion engines." Dec. 21.
23,428.—Ward, J., and The International Oil-Furnace Company, Ltd., "Portable furnace for application to boilers, gas-retorts, and the like." Dec. 21.
23,437.—Reiner, P., "Liquid meters." Dec. 21.
23,460.—Edmondson, J., and Dawson, J. W., "Internal combustion engines." Dec. 22.
23,478.—Waring, J. B., and Fox, H. L., "Pressure-reducing valves." Dec. 22.
23,513.—Lake, H. H., "Construction of gasholders and the like." A communication from Otto Intze. Dec. 22.
23,517.—Gillett, E. H. J. C., "Atmospheric burners." Dec. 22.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

Retort Ascension-Pipes.

Sir,—I quite agree with Mr. Harman in what he said in the "Journal" for Dec. 18 respecting the two sets of ascension-pipes and two hydraulic mains.

There is no need for two in any case. Where there are two ascension-pipes, it is necessary for both to be stopped before any obstruction is noticed. So long as one pipe remains clear, the gas will pass away all right. When any stoppage is noticed, one of the pipes is cleaned out, and then the retort is at once put to work. This I know from practical experience; and it goes on working all right with one ascension-pipe for months. The reason for not cleaning out the two pipes is that there is often not time to spare to do the work.

The writer has worked retorts 20 feet long for 46 years; and he has tried many schemes to prevent the stopped-pipe nuisance. The best thing he has found was to fit a machine inside the hydraulic main so as to keep the tar from becoming thick; and then he shut off one of the hydraulic mains, and used only one main for years, and it worked well. The number of stopped pipes was not worth noticing, as there were only a few, and the main was also kept clean from thick tar. It needed no summer cleaning out, and that is a great item.

East Ham, Dec. 22, 1900. S. Carpenter.

Explosive Gases from Electric Cables.

Sir,—In the "Journal" for Nov. 13 last (p. 1232), under the heading "Explosions of Gas," reference is made to the destruction of 50 yards of electric cable in connection with an explosion in Great Brickkiln Street, Wolverhampton. I do not know whether English engineers are aware that the Edison underground cable, when overloaded, produces a gas which cannot be distinguished from illuminating gas, and is the cause of explosions. The gas is first generated by overheating, due to excessive current; and the explosive mixture formed with air is fired by the short-circuit which ensues after a lapse of time of variable length, depending upon circumstances. I am convinced that our subway explosion of a number of years ago was due to this cause, though attributed at the time to gas from the Gas Company.

We have had a number of gas explosions due to the Edison system; and a few days since we had another one in Boston from this cause. I enclose a copy of the paper describing this, which may be of interest.* It would be well for gas engineers to know these facts if this system is used in their districts.

Boston, Dec. 18, 1900. W. R. Addicks.

A conference of representatives of the Elland, Greetland, and Stainland District Councils is to be held about the middle of the month to take into consideration what their combined action should be with respect to the Bill which has been introduced into Parliament by the Elland-cum-Greetland Gas Company. A suggestion is made that the authorities should ventilate the question of purchasing the works; but attention has been called (in a local paper) to the large expenditure such action would entail.

* An account of the occurrence referred to will be found in our "Miscellaneous News."—Ed. J.G.L.

LEGAL INTELLIGENCE.

More Welsbach Litigation.

In the Chancery Division of the High Court of Justice, Mr. Justice Farwell had before him on the last day of the Michaelmas Sittings a motion by Mr. Moulton, Q.C., on behalf of the Welsbach Incandescent Gas-Light Company, for an interim injunction to restrain the Standard Gas-Light Company from committing an infringement of certain letters patent of 1893, relating to gas-mantles. The learned Counsel stated, in reply to his Lordship, that the validity of this patent had never been established in Court, for, although a great many actions had been commenced upon it, a case had never yet been brought to trial. In the present matter, the action had been brought immediately the plaintiffs heard what the defendants were doing. Mr. Justice Farwell pointed out that it would be very inconvenient to try the question on a motion, and he suggested that leave should be given to advance the trial. Mr. Jenkins, Q.C., who appeared for the Standard Company, said he required time to prepare his defence, as the case was an intricate one. After some discussion, it was arranged that the motion should stand over to the first motion day next sittings, when, if all the necessary pleadings were ready, an early day could be fixed for the trial.

Payment for Work under the Swansea Reservoir Contract.

In the Queen's Bench Division of the High Court of Justice, Justices Kennedy and Darling, sitting as a Divisional Court, recently had before them the case of *Paterson and Son, Limited, v. The Council of the County Borough of Swansea*. The Hon. J. D. Fitzgerald, Q.C. (Mr. L. Macassey with him), who appeared for the plaintiffs, said this was a special case stated by Mr. George H. Hill, the Arbitrator on certain points in dispute between Messrs. Paterson and the Borough Council of Swansea. The arbitration arose under a contract dated June 7, 1898, by which the Contractors undertook to construct a reservoir and certain other works for the Corporation for a lump sum of £255,000 odd. The conditions of contract contained the usual clause that during the progress of the works advances were to be made by the Corporation to the Contractors at the rate of 80 per cent. of the value of the work executed; and the only question upon which the Arbitrator had sought the opinion of the Court was whether, under that clause, the work to be valued was the whole work executed up to date, or only certain portions of it. The Contractors claimed to have included in the valuation of the work done for the purposes of advances certain works which were necessary for the carrying out of the agreement. These had caused an aggregate outlay of £40,000, and their Lordships would find that, under the contract, as soon as these works were executed, or the materials brought upon the ground, they became the property of the Corporation. The question really arose on the words, "advances on the value of the work executed." Was it the value of the whole of the work, or only of some part of it? If it was the value of the whole work executed, then the Contractors were entitled to have taken into account all the matters which were necessary for the carrying out of the contract, and which became the property of the Corporation. Mr. Joseph Walton, Q.C. (Mr. S. T. Evans, M.P., with him), submitted that matters of preparatory work had nothing to do with the Corporation; and the Engineer had no power, under the conditions of contract, to certify any valuation of them for advances, because they were not included in the schedule of prices by which he was bound. Their Lordships held that the Contractors were not entitled to any advances for these temporary works, as they did not come under the definition of "work executed," which referred only to the subject-matter of the contract. Judgment was accordingly given for the Corporation, but without costs.

A Lighting Dispute leads to a Libel Case.

Quarrels between Gas Companies and Local Authorities as to the gas supply for public lighting are of frequent occurrence; but it is not often that they go so far as to come within the law of libel, as occurred in a case recently disclosed in the Court of Session. Mr. Dewar Paton, the Chief Magistrate of the burgh of Largs, brought an action for £500 as damages for slander, against Mr. John Watson, the Chairman of the Largs Gaslight Company, Limited. The pursuer said that in last August a difference arose between the Commissioners of the burgh of Largs and the Gas Company as to the terms upon which the Commissioners had been supplied by the Company with gas for the public lighting of the burgh, and as to the terms upon which gas should be supplied in the future. In the "Largs and Millport Weekly News" of Sept. 1 an article appeared commenting on the matter; on the 8th there was published a letter, written by the defender, accusing the Commissioners of having defrauded the Gas Company; and on the 15th there was published a letter by the pursuer defending the Commissioners. In the same newspaper of Sept. 22 the defender published the following letter: "Provost Paton's official reply to my letter appears in your edition of last week. It is clear that the Provost, like his brother Boers, has now become completely demoralized. Burns said some books are lies from end to end; and the poor Provost's silly production is ditto, double ditto. He has some method in his lying. Like the rats—he tries to make a hole to escape, by saying 'I was informed so.' I will not take up your space, nor further expose his mendacity by naming his particular falsehoods. He has been the sole cause of the burgh being in darkness. Commissioners Barr and Morris met with Dr. Caskie, Mr. Barclay, and myself on Tuesday evening, and settled what the Provost could have settled weeks ago; but he wanted a dispute, and has managed to air his hypocrisy and falsehood." When the case was called, Mr. Cooper for the defender unreservedly retracted every statement in the letter which the pursuer considered to be an impeachment of his truthfulness or to charge him with hypocrisy, and declared all such statements to be unfounded. He also apologized for having written them and caused them to be published, and tendered £50 to the pursuer as solatium, with the expenses of process. The action was taken out of Court upon these terms.

MISCELLANEOUS NEWS.

GAS SCHEMES FOR NEXT SESSION.

The Projects of the Metropolitan Gas Companies—The Mond Fuel-Gas Scheme.

Prints of the Private Bills relating to gas and water supply to be submitted to Parliament next session having been deposited, in compliance with Standing Orders, in the Private Bill Offices of both Houses, we shall commence next week our usual abstract of them. In the meantime, we give an indication of the scope of the measures promoted by the two Metropolitan Gas Companies, and by the projectors of the scheme for supplying Mond producer gas in the Midlands.

The Gaslight and Coke Company will apply, in accordance with the terms of the notice published in November, for power to raise additional capital, and to purchase, take, and hold certain lands. Authority will be sought to create and issue debenture stock not exceeding the nominal amount of £1,000,000 sterling, which is to be offered for sale by public auction or tender at a reserved price to be fixed by the Directors; and present holders of the Company's stock are not to be entitled to any preference or priority as regards tendering for or purchasing any of the new stock, which is to be known as the "second 3 per cent. debenture stock," and to rank next after the Company's 3 per cent. consolidated debenture stock. All debenture stock created or authorized by the Act, or any Act to be made and passed in the future, and the interest on such stock, is to have priority over all principal moneys and the interest thereon secured by mortgage, bond, or debenture hereafter authorized. An important feature of the Bill is contained in clause 7, which relates to the creation of a redemption fund. It is set forth that the Company are not, in respect of any one "calendar year," to distribute, to the holders of the ordinary stock, dividends to an amount exceeding 4 per cent. upon the total nominal amount of such stock for the time being continuing to subsist without making such provision for redemption as is specified in the Bill. Whenever the divisible profits during any calendar year are in excess of the amount required to enable the Company, save for the provisions in regard to redemption, to distribute in respect of such year dividends in excess of 4 per cent. per annum upon the total nominal amount of the ordinary stock, and the authorized rate of dividend exceeds 4 per cent., the Company shall, at the end of such calendar year, set aside as a redemption fund such excess up to a sum equal to 5s. per cent. upon the total nominal amount of ordinary stock (issued and unissued), as fixed by the Company's Act of 1898. Subject as above set forth, the Company may apply their divisible profits in any manner in which they can now be used "except that the authorized rate of dividend of the year shall be (in regard that the redemption fund has been set aside) deemed to be, for the purpose only of the actual dividends distributable in such year, reduced by the rate of the percentage which the year's redemption fund is upon the total nominal amount of ordinary stock." The redemption fund is to be applied, during the year following that at the end of which it is set aside, in purchasing ordinary stock of the Company, which is to be thereupon cancelled and extinguished. The reserve fund is not to be used for the purpose of distributing in any year to the ordinary stockholders a dividend in excess of 4 per cent. The rest of the Bill is to authorize the Company to hold certain scheduled lands, and use them for the construction and maintenance of gas-works.

The main object of the South Metropolitan Gas Company, by the Bill they have deposited, is to obtain power to raise additional capital, and to purchase so much of the undertaking of the Gaslight and Coke Company as is situated south of the Thames. In attaining this object, it will be remembered, they were unsuccessful last year. Clause 3 gives the two Companies power to enter into and fulfil agreements for, and in relation to, the purchase and transfer of the undertaking; and it specifies that all money received by the Northern Company for the sale of the portion of the works in question is to be employed for any purpose for which they are authorized to apply capital. The promoting Company ask for power to raise more money, not exceeding £1,500,000, by the creation and issue of stock; but in the event of the purchase above referred to not taking place, the sum named is to be reduced to £750,000. It is proposed that before any unissued stock is submitted to other holders of the Company's stock or to the public, it is to be offered, with the approval of the Board of Trade, to the gas consumers and persons in the employ of the Company, at not more than 7½ per cent. below the average market price in the month immediately preceding the offer. Stock not taken by them is to be put up to auction or tender, in lots of not more than £100 nominal value; and if it is not all disposed of, the shareholders may be invited to take the remainder. The Company also ask for power to issue 3 per cent. debenture stock to the extent of not more than one-third of the amount received in respect of the capital authorized to be raised, and at the time actually issued by stock, but not until after the whole of the stock, with the premiums thereon, has been fully paid up. The remaining clauses of the Bill incorporate parts of the Companies' Clauses Consolidation Act and the Company's Act of 1896, and specify that the new capital is to be applied only to the purposes of the Act.

We have already noticed (see "JOURNAL" for the 4th ult., p. 1409) the important scheme for the supply of Mond gas for power and heating purposes in the Midlands. The deposited Bill consists of 53 clauses and three schedules. The preamble sets forth that certain parties named (with others) are willing to undertake the manufacture and supply, within parts of South Staffordshire and East Worcestershire, of gas, "and particularly of the gas commonly known as Mond Gas, for the purposes of motive power and heating, but not of illumination." The "parties" referred to are Joseph Braham Cochrane, Gilbert Henry Claughton, Sir Benjamin Hingley, Bart., Edmund Howl, George M'Pherson, and Ludwig Mond, who are to be the first Directors of the Company; and two others are to be nominated by them. The capital is to be £1,000,000, in 100,000 shares of £10 each, with borrowing powers to the extent of one-third. In addition to the production and supply of Mond Gas, the Company propose to "manufacture, sell, and deal in sulphate of ammonia, and any other bye-products or residual products of coal." The district to be supplied comprises the following boroughs and other urban and rural districts: Dudley, Smethwick, Walsall, Wednesbury, West Bromwich, Wolverhampton, Amblecote, Bilston, Brierley Hill, Coseley, Darlaston, Handsworth, Heathtown, Lye and Wollescote, Oldbury, Perry Barr, Quarry Bank, Rowley Regis, Sedgley, Short Heath, Stourbridge, Tipton, Wednesfield, Willenhall, Halesowen (Rural), Kingswinford (Rural), and Walsall (Rural). For the purposes of the works, land to the extent of 54 acres has been scheduled in Tipton, 26 acres in Bilston, 16 acres in Darlaston, 8 acres in Kingswinford, and 30 acres in Smethwick—in all, 134 acres. This is to be acquired compulsorily before the expiration of three years from the passing of the Act. It is also proposed to purchase an additional 75 acres, not to be used for manufacturing purposes. The power to lay mains and pipes and open up streets is conferred by clause 33, which runs as follows: "Subject to the provisions and restrictions of this Act and of the Acts incorporated herewith the Company may lay, place, maintain, alter, and remove mains, pipes, and other apparatus, in, under, along, or above any street within the district, and may (so far as necessary for the purposes of this section) open, break up, and interfere with any such street, or any sewer or drain, or any gas or water mains or pipes, or any electric, pneumatic, or other wires, lines, tubes, pipes, or apparatus." Notice is to be given to the Postmaster-General when the Company's works affect a public street or bridge. Any authority liable to repair any street, or entitled to work a railway or tramway, are to be empowered, if they think fit, to break up and reinstate the roads for the Company, at the expense of the latter. Under clause 37, the Company may alter the position of any mains, pipes, wires, or apparatus under any street or place authorized to be broken up by them which may interfere with the exercise of their powers; and any body or person may alter the position of any mains or pipes of the Company which may "interfere with the lawful exercise of any power vested in that body or person in relation to that street or place." It is provided that one month's notice shall be given; and that compensation is to be settled by arbitration. The Company are to furnish a supply of gas to any premises situate within 25 yards of a main, and provide and lay any pipe required for the purpose. A consumer may be required to enter into a written contract to take not less than a million cubic feet of gas per quarter, and to continue to receive and pay for a supply of gas for at least two years. The charge is not to exceed 3d. per 1000 cubic feet if the quantity taken is not less than 4 millions per quarter, and 4d. if it is less. Should the price of slack "of good quality" exceed 6s. per ton delivered at the works of the Company, the charge for gas may be increased beyond the above-named maximum by ½d. per 1000 cubic feet for every 1s. per ton. Should the profits in any year be more than sufficient to pay 10 per cent. dividend, one half of the surplus is to be set aside to form a reserve fund, and the other to be returned to the consumers in the shape of a rebate. The reserve is to be invested, and is to accumulate at compound interest till it reaches £100,000. The Company are to furnish copies of their accounts to the Local Authorities in their district, to be responsible for all damages, to be liable to proceedings for nuisance, and are not to have any monopoly of the supply of gas. The following are the patents for which the Company will be granted a licence as soon as 22,500 shares have been taken up: No. 12,440, June 24, 1893; No. 16,781, Sept. 7, 1895; No. 28,588, Dec. 14, 1896; No. 27,257, Nov. 20, 1897; No. 28,367, Dec. 1, 1897; and No. 17,001, Aug. 6, 1898. For the use of these patents, and any improvements thereon, Mr. Ludwig Mond is to receive 7500 shares in the Company—2500 when the grant of the licence takes place, and the remainder in instalments as the number of shares in the Company increases. He is also to receive half the royalties arising from granting sub-licences in the Company's district.

PARIS GAS QUESTION.

At the close of the report which the Directors of the Paris Gas Company presented to the shareholders at the annual general meeting last March, it was stated that negotiations were in progress between them and the Municipality for the settlement of the apparently interminable gas question, which appears to have given rise to as much trouble in Paris as the water question has done in London. The cases are, however, not exactly similar, inasmuch as here the suppliers and consumers alone are concerned, and the shareholders get the benefit of whatever profit is made by the undertaking. In Paris, on the other hand, the profits above 10 per cent. are divided, as our readers may remember, between the Company and the Municipality. In addition, the latter receive 2c. per cubic metre of gas consumed and an annual rent for the occupancy of the subsoil by the mains. As a set-off, the Company were allowed, under their Treaty of 1870, before sharing their profits with the Municipality, to set aside annually a sum of 12,400,000 frs. for seventeen years, and 11,200,000 frs. for the rest of the concession, which will expire at the end of 1905. Furthermore, they were to be relieved of the *octroi* duty on their coals, and were authorized to charge 30c. per cubic metre, or about 6s. 9d. per 1000 cubic feet, for their gas. Another condition of the Treaty which materially affects the question is that under which the Municipality become owners of half the property of the Company at the end of the concession.

It has been recognized for a long time that the consumers in Paris are being made, under the existing arrangement, to pay a great deal more for their gas than those of other French cities—Bordeaux, Lyons, and Marseilles, for example, where the price is only 20c. per cubic metre, or about 4s. 6d. per 1000 cubic feet; and even this is a higher rate than that to which English consumers are accustomed. Attempts have consequently been made from time to time to obtain a reduction in Paris. The gas question has constituted a very substantial "plank" in the platform at succeeding municipal elections; and it was quite expected that the new Council chosen in the spring would be able to come to terms with the Company. The latter, on their part, have not shown a disinclination to concur in what they would regard, in view of the fact that they are in possession of a monopoly which has now five more years to run, as a just and equitable arrangement to all parties concerned—the shareholders, the consumers, and the Municipality.

Various schemes were submitted to the old Council; but they came to nothing. Soon after the elections, however—in fact, on the 27th of June—the Company made a fresh proposal, under the terms of which the price would be lowered to 22c. per cubic metre as from the commencement of the present year, and to 20c. on Jan. 1, 1906, or from 6s. 9d. to 5s. and 4s. 6d. per 1000 cubic feet. This reduction was to be made conditionally upon the prolongation of the concession for a substantial period—say, from 50 to 60 or 75 years—the purchase of the city's share of the works and distributing plant, the re-arrangement of the capital, and provision for its liquidation by the end of the concession, when the whole concern would become the property of the Municipality. After three months' negotiation, this proposal was sent to the Municipal Council by the Prefect of the Seine, accompanied by the expression of an unfavourable opinion in regard to it. It was suggested, however, that if the negotiations were continued an understanding might be eventually arrived at.

The proposal was referred to the First Committee of the Council, who duly examined it. They took a less uncompromising view of it than the Prefect, inasmuch as they accepted some of the suggestions. At the same time, they raised serious objections to two others—viz., those specifying that there should be an increase in the charge for gas in the event of a rise in the price of coal, and that the purchase price of the moiety of the undertaking should be 77,000,000 frs. (£3,080,000). The Committee asked the Company's representatives, when they met in conference, to give up these two points. But, after duly considering the matter, they firmly declined to do so. Their decision was conveyed to the Committee in a letter dated the 10th ult., and received by them the next day. This brought matters to a deadlock. At the meeting of the Committee on the 19th ult., M. Alpy presented a report on the subject, and stated that, in the face of a communication couched in such unmistakable terms, no other course was open to them than to break off definitely negotiations which had been commenced with so much labour, as it was simply impossible to continue them as the Prefect of the Seine had suggested. He concluded by saying that, as their recent experience had demonstrated once more the impossibility, notwithstanding their conscientious efforts, and the proofs of perfect good faith they had adduced, of relieving themselves of the heavy burdens which had been put upon them by the Treaty of 1870, they had only one duty to discharge to the citizens of Paris, and that was to ensure for them, in the future, at all events, as ample compensation as possible for the great sacrifices which it was at present beyond their power to obviate. He concluded by submitting a resolution to the effect that, inasmuch as the excessive demands made by the Gas Company, in the interests of the shareholders, had made it once more impossible to come to an understanding with the view to an immediate reduction in the price of gas, the following recommendations should be submitted to the Council for their consideration:—

1.—That the Prefect of the Seine should be invited to continue without intermission the proceedings commenced against the Gas Company before the Prefecture of the Seine by the City of Paris in accordance with a request made on July 25, 1895, with the following objects: (1) To ascertain exactly the rights of the City of Paris, under existing Treaties, with respect to the fixed and moveable plant of the Company on Dec. 31, 1905. (2) To settle in advance, with the aid of experts on behalf of both parties, the actual value of the moiety of the Company's assets for which the city will have to pay under the aforesaid Treaties, with the exception of the distributing plant, which will become the property of the city without indemnity. (3) To settle the conditions under which this payment is to be effected so as to obviate any difficulty of such a nature as to cause an interruption in the public lighting service when the city takes possession on Jan. 1, 1906.

2.—The Prefect of the Seine is further invited to prepare, without delay, a specification of the conditions under which the future working of the concern will be organized, in view of the fact that the price of gas is to be fixed at 10c. per cubic metre for the public lamps, 15c. for motive power, and 18c. for private lighting.

3.—The Prefect of the Seine is requested to report to the Council, before the 1st of May next, the results of his proceedings in the matters above referred to.

After having heard the report of M. Alpy read, the Committee adopted its conclusions unanimously.

The subject came before the Municipal Council on the 22nd ult., at the close of a long sitting. Just as the members were about to separate, MM. Deville, Rendu, and Carron submitted a counter-proposition to the effect that all the existing Treaties should be cancelled as from Dec. 31, 1900, and possession of the works taken by the city on Jan. 1, 1901; the management of the concern to be placed in the hands of a "farming" company to be constituted for the purpose, and the price of gas to be at once reduced to a fixed figure of 20c. per cubic metre. The financial features of the scheme were outlined in the proposition. M. Alpy, while maintaining the conclusions adopted unanimously by his Committee, confessed that he saw no reason why the new proposal should not be considered before they came on for discussion. A rather stormy debate ensued; some members being desirous of having the question brought forward at a special sitting of the Council. In the end, it was decided to place the matter after the order of the day for the following Monday. But inasmuch as the Municipal Budget was to be taken that day, there was not much chance for the Gas Question. The Council met soon after nine in the morning, and discussed till midday the problem of how to find an additional twelve millions required for the current year. Before the adjournment for luncheon, however, it was decided to have a special sitting early this month at which the proposals in regard to the Gas Company and their undertaking could be considered; several councillors being of opinion that the subject should be thoroughly investigated, for which there was certainly no time that day. The Council resumed shortly after two o'clock, and sat till seven, when there was another interval of two hours. The rest of the day was occupied discussing the budget of the Prefecture of Police.

The consumption of gas at Lancaster shows progressive increases. The figures for the past half year disclose an increase of nearly 3 million cubic feet, or 5·64 per cent. over the increase of the previous year. Two years ago, the advance in the corresponding period was under a million cubic feet; and in the following year, it was a little above 2 millions.

DEVONPORT CORPORATION AND THE GAS-WORKS.

Adoption of the Purchase Scheme.

The Devonport Town Council recently held a Statutory Meeting to consider resolutions authorizing the promotion in the ensuing session of a Bill for the purchase of the undertaking of the Devonport Gas Company. The MAYOR (Mr. Harman J. H. Graves) presided.

Mr. G. A. RAE asked at the outset whether members of the Council who are shareholders in the Gas Company could take part in the discussion, and had any power to vote; and on being answered in the negative, said some of them might as well go home.

The TOWN CLERK (Mr. A. B. Pilling) said they would have an opportunity of both speaking and voting at the ratepayers' meeting.

The MAYOR then moved a resolution authorizing the promotion of the Bill. He reminded the Council that at the last meeting a report presented by the Gas Committee was adopted. They were now asked to express by their votes the opinion that, in the public interest, the supply of gas to the inhabitants of Devonport should be administered by the Municipality. He believed the majority of people, including even those who were personally interested in the undertaking, admitted the principle that the supply of such a commodity as gas, which was an absolute necessity to the public convenience and comfort, should not be in the hands of a private Company. It was desirable that there should be little discussion at that meeting, and the Committee should not be obliged to give information to the opposite party, who, he was afraid, were going to fight, and were not at all likely to meet the Council, even if the door of negotiation were opened to them.

Mr. W. HORNBROOK seconded the motion.

Alderman H. W. BRYANT objected to giving a vote blindfold. They must consider what they were going to buy. In his neighbourhood, people were altogether against the scheme. If they bought the gas-works, it would cost thousands of pounds before the thing was done. They would have to buy the present mains, which were insufficient; and when they had obtained the works, everybody would want new mains laid. They were told that electricity would supersede gas. They had only to induce shopkeepers and private residents to take the electric light, and they would clear out the Gas Company in a very short time, or at least be able to buy the undertaking much cheaper than they could at present.

Alderman J. B. JAMES said there was a practically universal complaint in Devonport as to the poorness of the supply of gas. The fact was that while the area of the borough had increased, and the demand for gas had largely grown, the policy of the Gas Company had been to limit the amount of their capital expenditure, with the result that the mains were too small and the town was insufficiently supplied. The Company saw this, and recognized their responsibility, and they were now applying to Parliament for powers to increase their capital. If they succeeded, the Council would find the prospect of municipalizing the gas-works much more difficult. Experts advised them that the present was, above all others, the opportunity for acquiring the works, and if missed it would probably never recur. They were, however, desirous of doing justice both to ratepayers and to the shareholders of the Company. They did not want to mulct the Company of one halfpenny. They simply wished to control the gas-works for the public benefit. The idea that electricity would altogether supersede gas had been dispelled by the experience of other towns. Gas was coming more and more into use for domestic purposes and for motive power, and gas and electricity would run alongside, and be of advantage to each other.

Mr. G. H. SMITH, jun., expressed the opinion that the Council should not be called upon to decide so important a matter upon such meagre information as they possessed. They might, he thought, meet in Committee in order to obtain additional particulars.

Mr E. DOWN objected on principle to the municipalization of property, and considered that the interests of the town were best served by private enterprise. Even if it were desirable for the town to purchase the gas-works, the present was not a suitable time for doing it. If they bought the undertaking, they would have to extend the works and lay down new mains, and these things would involve them in very large expenditure.

Alderman S. D. BROOMING proposed, as an amendment, that the meeting should be adjourned *sine die*, to enable the Council to discuss the subject in Committee. They ought to know something of the estimated cost. No interest would suffer from postponing the matter.

Mr. G. H. SMITH, jun., seconded the amendment, for, though he believed that, under certain conditions, municipalization of property might be the best policy, they ought to know something of the conditions in order to be in a position to form a judgment.

The TOWN CLERK remarked that the present was only one of three separate steps which had to be taken to forward the promotion of the Bill. He agreed with those who required more information to the extent that if he were asked to give final judgment upon so large a question as the gas purchase he should decline to express it unless he had a great deal more information than the Council had been put in possession of. They were not asked to express a final judgment that day, but merely to affirm the general principle that they approved of the promotion of a Bill for the acquisition by the community of the gas undertaking. Probably at the meeting of owners and ratepayers it would be necessary to make some more complete statement. They would no doubt have opposition to deal with; and foreseeing opposition he strongly protested against being asked to state that day to those who would be his opponents in the future what his case was going to be, so that they might have ample leisure to sit down and prepare an answer. Certain accounts of the Gas Company had been investigated, so far as this could be done, as they had refused to allow their works to be entered or their books examined. They had failed to file with the Corporation certain accounts which, under the Gas-Works Clauses Act, 1871, it was their duty to furnish each year; but, on being threatened with legal proceedings, they supplied them for ten years. The annual abstract of accounts which was required to be filed with the Clerk of the Peace for the county had not been sent in since the year 1880, and before copies could be obtained the Corporation had again to talk about the powers given to them by law. So far as they had been able to go in

respect of these accounts, investigations had been made, and the report the Gas Committee had received informed them that the Company were "exceedingly vulnerable to attack." In one respect the Committee were so impressed with the contents of the accounts that they instructed him to ask, at the next Court of Quarter Sessions, for the Recorder to exercise his powers under the Gas-Works Clauses Act, 1847, to appoint a competent person to go to the gas-works and examine their condition. Did they think the Gas Committee would take a step like that without good reasons for doing so? They had good reasons for their action; but it was not in the public interest that they should at present be forced to disclose them.

An appeal was made to Alderman Brooming to withdraw his amendment, in view of what the Town Clerk had stated. The amendment was, however, pressed to a division, and was defeated by 26 votes to 10. As the voting showed that a majority of the Council—31 members—was apparently not in favour of the resolution, another amendment was submitted with the object of adjourning the meeting to an early date this month. After some remarks, in the course of which several members of the Council announced their intention to waive their opposition, the amendment was withdrawn, and a vote taken on the resolution, which was carried by 32 votes to 2.

AN ACETYLENE EXHIBITION.

And a Misleading Title.

An exhibition, to which the ponderous and decidedly deceptive title of "Gas and Allied Trades and International Acetylene Exhibition" has been applied, is now being held at the Royal Aquarium, Westminster. The organizers are to be complimented on their strength of imagination in devising such a title for such a display of apparatus as is to be seen, and on their boldness in advertising it up and down the country under such a description. If the first six words were eliminated from the appellation, there would be nothing much to complain about; but, as it is, "gas and the allied trades" are misrepresented to the public by three or four small stands, and the remaining exhibits are entirely connected with acetylene lighting. We hunted high and we hunted low, but all we could find of interest for the big industries covered by the above-quoted words were: First, the stand of the Birmingham Incandescent Lighting Company, Limited, whose cheap burners and mantles were recently noticed in the "JOURNAL." Second, stands furnished by Messrs. Defries and Sons with their cut crystal illumination devices (about which we failed to discover anything novel in the way of design), specimens of their differential gas regulators and economizers (which are said to possess the efficacy of saving from 15 to 55 per cent. more than other gas-governors), and a pneumatic safety lamp for lighting small towns, to which the power is attributed of being able to give a light equal to three gas-burners at one-eighth the cost, but we did not stop to inquire closely into the grounds for this statement. Third, Messrs. Thorpe and Salter have on view the "Ruby" (very) small power gas-engines, which are suitable for driving coffee mills, small pumps, &c. Fourth, there is an exhibit of the "Crownall" and "Beetall" gas-irons for laundry work, by which economical housewives will be glad to learn "a whole day's ironing" can be done for a penny. The "allied trades" are represented by a few trucks, bicycles and accessories, and an "energizing momentum engine." This sums up the whole of what is to be seen of immediate or remote interest to the coal-gas industry, other than acetylene gas; and therefore the gas manager who is allured by the title into paying a visit to the exhibition with the view of seeing the best and latest connected with coal-gas lighting will assuredly come away vastly disappointed, and with a few uncomplimentary words on his lips.

The acetylene people have the show practically all to themselves; and, while it cannot be said that they present anything that is absolutely new, on, and in connection with, half-a-dozen of the principal stalls visitors may see some of the best of the competing acetylene appliances now on the market, as well as examples of the lighting. Space cannot be devoted to a description of the construction of the apparatus; our "Register of Patents" has kept readers informed of progress in this direction. Among the stands those which will be found worth inspection are fitted up by the "Ideal" Gas Company, the "Sunbeam" Acetylene Gas Lighting Company, the "Economic" Acetylene Gas Generator Syndicate, Husson's Safety Acetylene Syndicate, Mr. H. Jameson Davis (the Gregory-Smith generators and purifiers), Turr's Acetylene Gas Syndicate, and the Forbes Acetylene Company. The "Ideal" Company's exhibit will claim the attention of visitors interested in gas lighting, as this is the system which has been adopted for the lighting of the village of Hunmanby, in Yorkshire; and several well-known country establishments have been equipped with it. The apparatus is strongly constructed, and its operation appears to be simple. By the attendant we were informed that, at the present price of carbide, the acetylene gas produced by this system compares with coal gas at 3s. 6d. per 1000 cubic feet, light for light; that on a rough estimate it costs ¼d. per light per hour consuming ¾ foot, and giving an illuminating power of from 25 to 28 candles; and that at a pressure of 2½ to 3 inches, a No. 3 burner will give 28 to 30 candle power, with a consumption of ¾ to 1 cubic foot of acetylene. The burners used are of French make; and they may be estimated as follows: No. 1, consuming 10 litres of gas, gives a light of 5-candle power; No. 2, consuming 20 litres 12 to 16 candles, and No. 3, consuming 30 litres, 25 to 28 candles. With the first group of figures before him, the reader will be able to readily make his own comparisons with coal gas flat-flame and incandescent burners, and ascertain how near the 3s. 6d. approaches the true relation between these systems and acetylene lighting. The "Sunbeam" apparatus is in close proximity. It is constructed under Williamson's patent combined system; and the plant on view consists of generators and all the necessary accessories. Next comes the "Economic" Syndicate's exhibit. This plant requires little room, and is automatic in action. The cost over all is claimed to be lower than that of any other system; and an equivalent of from 2s. 6d. to 3s. per 1000 cubic feet of coal gas is stated to cover everything—even cost of plant, installation, maintenance, and so on. The apparatus and lighting by Husson's Syndicate also have points which will interest the inquirer. The apparatus is non-automatic; there is no excess of water, and therefore the gas is said to be generated cold; and consequently it is claimed to be much purer than gas produced hot by other systems. The carbide is simply dropped into an open hopper at the top of the generator; and this can be done while the gas is alight, so that it is the simplest thing imaginable to keep the apparatus in operation. In this case the cost is put at the equivalent of (or slightly under) 3s. per 1000 feet of coal gas, light for light. We cannot afford space for more than one other exhibit, and that is the apparatus and fittings of Turr's Acetylene Syndicate, who make a very respectable display. It is pointed out that the generators occupy little space; there is a cool generation of gas; and holders are not considered a necessity with this system. But it seems to us that, for the maintenance of a uniform supply where the consumption is erratic, storage is absolutely essential, especially in the case of village lighting, for which the Syndicate are mainly aiming. Even if the gas cost the equivalent of 4s. per 1000 cubic feet of coal gas, the Syndicate claim that it will be in comparison a cheap means of procuring light in country places; but recent computations put the equivalent cost, light for light, at the low figure of 2s. 8d. On this point, however, a little more information would be interesting.

There are a few other acetylene exhibits; but the foregoing are the most representative ones. The impression the exhibition as a whole gives one is that in respect of the lighting power of the gas produced under the various systems, there is little to choose between them—cost, safety, ease of manipulation, and productive power are the factors which will weigh with inquirers and determine their preference.

FINANCING THE SCOTT-SNELL LAMP.

The drudgery and close application inseparable from the launching of a new patent of exceptional pretensions having been accomplished in the case of the Scott-Snell self-intensifying gas-lamp, there has emerged from the original Scott-Snell-Phillips Syndicate a Company who will work and exploit the invention under the style of "The Scott-Snell Self-Intensifying Gas-Lamp Company, Limited." The Company acquire the British patent No. 14,086, of 1899, and the patents for Belgium, France, and Italy, together with the benefit of applications for patents which have been made in some two dozen other countries (five of these applications have, we learn, recently been granted). In addition to the present patents and applications, the Company also possess the right to all future improvements in the invention covered by the patents in relation to gas lighting made, or to be made, by, or on behalf of, the vendors. The prospectus of the new Company is a frankly drafted document; but the formation of the Company and the subscription of the capital have been an entirely private affair. This being so, deprives of point any criticism that might be passed as to the amount of the share capital—viz., £1,000,000, which is divided into 100,000 7 per cent. cumulative preference shares of £1 each, and 900,000 £1 ordinary shares. As a matter of fact, however, only the 100,000 preference shares have been issued; and for the protection of the holders, a reserve fund of £100,000 is, by the Articles of Association, to be created out of the first proceeds of the sale, working, or exploitation of the foreign patents. The preference shareholders have the right up to June 30, 1902, to convert their holdings into ordinary shares at par, together with the right (to the same date) to call from the vendors, in respect of every two preference shares, one fully-paid ordinary share at the price of £2. All the ordinary shares are taken by the vendors in part payment of the purchase price, with £50,000 in cash or preference shares, so as to leave £50,000 for working capital. As the vendors take such a large proportion of their consideration in shares, it was thought well to arrange for the pooling of 750,000 ordinary shares until June 30, 1902, so as to guard against the vendors unloading unwisely.

The directorate is composed of four members—Messrs H. Corfield Bucknall (the Chairman), Mr. C. W. Phillips, Mr. C. Scott-Snell, and Mr. Maurice Lachman. Not one of these gentlemen can be called a "dummy" Director; each has his particular department of work. Mr. Bucknall is a well-known City man, Chairman of two Companies, and Director of others; and he will look after the finances of the new concern. Mr. Scott-Snell will continue to devote his talents to the inventive part of the business; Mr. Lachman, who is Managing-Director of Messrs. J. F. Pease and Co., Limited, will have the manufacturing department under his immediate care; and Mr. Phillips will deal with commercial matters.

Regarding the lamp itself, the prospectus contains two opinions of interest and value. The first is from Mr. T. Terrell, Q.C., who says he is satisfied that the invention is "novel." Then, in a report on tests he has made with the lamp, Mr. Dugald Clerk remarks: "On lighting the lamp, I found the photometer reading showed 65 candles. The gas pressure from the mains was 2¾ inches. Two minutes after lighting, the pressure had become automatically intensified to about 18 inches. The illuminating power then became 300 candles; and the light was given at the rate of 27-candle power per cubic foot of gas consumed. The intensifying apparatus started automatically immediately after lighting the lamp. The burner in the lamp was of an ordinary type, with an ordinary Welsbach mantle. I consider the results very good."

Omagh Gas Bill.—The Omagh Gas Company's Bill is to be opposed by the District Council; it being considered that the "public good" requires that all such supplies as gas, water, and electricity should be in the hands of the governing authority.

The Keighley Arbitration.—On the 20th and 21st ult., the arbitration proceedings between Messrs. Newton, Chambers, and Co., of Thorncliffe Iron-Works, near Sheffield, as plaintiffs, and the Corporation of Keighley, as defendants, arising out of the installation of mechanical coke-conveyors at the Keighley Gas-Works, were continued before Mr. Thomas Newbigging. The remainder of the evidence for defendants was concluded; the principal witness being Mr. Charles Hunt, of Birmingham, whose opinion was that flat-plate conveyors were not suitable for dealing with hot coke at gas-works. The proceedings were subsequently adjourned to the 23rd inst., when the closing addresses of Counsel will be made.

A FLOOD AT THE LEICESTER GAS AND ELECTRICITY WORKS.

Serious Curtailment of Supply.

As this issue of the "JOURNAL" was going to press, a telegraphic message brought the news that the heavy gales and rains of the past few days had wrought serious damage at the Leicester Corporation Gas and Electric Light Works; and, apart from the inconvenience to consumers, great anxiety and labour have suddenly enveloped the Engineer (Mr. Alfred Colson) and his staff. The works, we understand, are practically flooded; the water having broken in about 2 a.m. yesterday. Mr. Colson was immediately summoned, and arrived on the scene about 3 a.m. But the dead of the night was any but a favourable time for dealing with a grave disaster of this kind. The district round and the main road were something like 2 feet under water; and Mr. Colson had to wade into the works. He found the electric light engine-house and the basement of No. 1 retort-house flooded; and (as we gather from the message) No. 2 partially so. Fire-engines were at once set to work to pump out the water. But the effect is this, that the fires being out in the electric light engine-house, the production of electricity is suspended, as well as the make of gas in No. 1 house (which has a productive capacity of 3 millions), and No. 2 (which ordinarily is capable of yielding 4 millions) has had its make cut down one-half, or to 2 million cubic feet. In other words, the combined production of the two houses—viz., 7 millions—has been reduced to 2 millions; and thus it is feared that if the water continues to rise, the town will be thrown into darkness. Fortunately, so far as can be ascertained, no structural damage has occurred. The gas and electricity works are not the only sufferers by the floods; other parts of the neighbourhood are deep under water, and great trouble has resulted. It is a curious thing that it is exactly 40 years to a day—the last day in 1860—since a flood of similar proportions occurred in the district. Mr. Colson's professional friends will, with us, wish him speedy relief from the perplexing and unfortunate situation into which he has been precipitated.

CHRISTMAS TIME AT THE YORK GAS-WORKS.

Address by Mr. Charles Sellers.

The recurrence of Christmas afforded Mr. Charles Sellers, the Engineer and Secretary of the York Gas Company, another opportunity of strengthening the pleasant relations subsisting between himself and the workmen by distributing his customary gifts of toys, books, and useful articles to those who have children. As on previous occasions, he addressed to them a few seasonable and encouraging remarks. After expressing his best wishes that in their homes and at their own firesides they might have a Happy Christmas, he went on to say: "But while good wishes, as you all know, may breathe kindly sentiments, happy homes can only be made by the conduct of the heads of those homes. It is quite true that good wishes may suggest and stimulate good actions; but without actions the thing wished for cannot be brought about. And therefore, if a man wishes for a happy home, he must not only wish, but he must act, as the man acted who once wanted to cross a stream. When he got there the ferry boat was gone, so, instead of sitting on the bank and whining and wishing to get across, he rolled up his breeches and waded over. It is an old and unalterable law that 'whatsoever a man soweth that shall he also reap.' There is no mystery about it, and there is no getting away from it. Consequently, if a man sows thistles you will all agree with me that he will be an arrant fool if he expects to reap grapes. And as a man who wants grapes must plant vines and cultivate them, so if he wants a happy home he must act in such a way as to make such a home. I am very pleased to find that the old form of commemorating Christmas by what is called a 'jollification,' or, in other words, drinking and guzzling to excess, is in all decent society fast going out of fashion. And in addressing you this morning, I feel that the great majority of you will heartily agree with this change of fashion, as I know that you will all agree with Burns's picture of a husband's and a father's duty to make a happy home, where he says:

> To make a happy fireside clime
> To weans and wife,
> That's the true pathos and sublime
> Of human life.

I have referred, perhaps, rather emphatically to drinking customs; but I am proud to feel that the great majority of you are with me in denouncing the senseless habit as one upon which no happy home can be founded. In fact, the habit is, in the plainest of English, a sowing of thistles." Mr. Sellers then distributed the presents, and the recipients gave him three hearty cheers.

MUNICIPAL UNDERTAKINGS CAPITAL EXPENDITURE.

The Practice of the Birmingham Corporation.

At the Meeting of the Birmingham City Council to-day, the Finance Committee will present a report relating to a recent motion by Mr. Walthall to the effect "That as the responsibility of capital expenditure at all times rests with the Council, it is desirable for each Committee proposing to spend money on capital account to obtain the specific sanction of the Council before expending the same; and it is hereby resolved that the instructions to Committees, wherever necessary, be amended accordingly." The Finance Committee state that the present practice as regards expenditure on capital account is as follows: (1) In nearly all cases where expenditure is proposed which involves a direct charge on the rates for the interest and repayment of a loan, a report is presented to the Council containing general details of such expenditure. If the report be approved, an application is made to the Local Government Board, who, after holding an inquiry, and having full particulars before them, sanction the expenditure if they think it desirable. The Committee then generally bring up a contract for approval; but occasionally they report the acceptance of a contract. (2) With regard to expenditure for capital purposes in connection with the industrial undertakings of the Corporation—*i.e.*, gas, water, and electric supply—the Council have generally, on the recommendation of the Committee concerned, made application to Parliament for such amounts as seemed necessary. When an Act has been obtained authorizing the expenditure, the Council have deputed the carrying out of the work to the Committee having charge of the department, without going into further details. With regard to expenditure under the first head, Mr. Walthall's requirements are generally complied with; and they appear to be complied with under the second head also. But, in discussing the matter in detail, he states that he considers that, with certain exceptions, specific resolutions of the Council should be passed before the Committee (after having received a general authority) enter into any contracts or make any payments. He would not, however, carry the restriction to the extent of applying it to amounts under £10,000. This, he considers, would cover, to a great extent, replacements not paid out of revenue, expenditure on new mains, or such other routine charges as must necessarily occur in constantly developing undertakings of this nature. It would, therefore, apply to such additional manufacturing plant as gasholders, engines, purifying plant, and dynamos, the erection of buildings, and the purchase of land or additional sources of water supply, when in any specific case the expenditure amounted to £10,000 or upwards. The following case may be given as an illustration of how the alteration would work: The Gas Committee reported on Feb. 1, 1898, that they had accepted the tender of Messrs. C. & W. Walker for a new gasholder at a cost of £38,000. Under the proposed new system, they would have reported (say, a few months earlier) that they recommended the Council to accept the tender of Messrs. Walker, or that they had received tenders from such and such firms, and recommended the acceptance of the above. The present practice with regard to the Gas and Water Departments has been in force for 25 years, and has worked satisfactorily. In many cases expenditure of this class involves questions of a highly technical character, in which the Committee must, to a great extent, be guided by the advice of their responsible officials and information of a personally confidential character, and such expenditure is not, therefore, adapted for general discussion in public. The Finance Committee are not prepared to recommend any alteration in the present practice. While, however, not agreeing with Mr. Walthall on the above specific proposals, they do recognize that in some cases more details of the proposed expenditure on the industrial undertakings might be given, such as outlines, at least, of the information that must be supplied to the Local Government Board before they will sanction the proposed borrowings.

THE FATAL GAS EXPLOSION IN DUNDEE.

In the "JOURNAL" last week we briefly reported the serious explosion of gas, unhappily attended by the loss of two lives and injury to several people, which occurred at the premises of Messrs. Smith Bros., Dundee, on the 20th ult. The fuller particulars since to hand do not materially alter the facts recorded; and we only return to the subject to emphasize the importance of leakages of gas being traced by experienced persons only. The building had a front shop with a floor-space of 1350 feet; while in the basement below there was a large wareroom having a superficial area of 2068 feet. On the same level were the workrooms for the male and female operatives. The seat of the explosion was in the latter department. At a quarter-past five o'clock on the day named, ten females were busy putting the finishing touches to the day's work. For some time a smell of gas permeating the apartment had been the subject of remark; and ultimately it became so obnoxious that complaint was made to one of the shop staff. At the moment a plumber who was working on the premises in connection with the water-fittings chanced to be absent, and in the circumstances Allan Ferguson, the porter and "handy man" of the establishment, took it upon himself to remedy the defect, which had been located somewhere near the middle of the floor. It appears that he took the precaution to turn the gas off at the meter; and, as a consequence, the workers were thrown idle for the time being. Ferguson, with a lighted candle, proceeded to the centre of the room, where the leak was supposed to be. With him was an apprentice named Richard Cameron. The floor on which Cameron and he were standing was a double one—a space of about a foot separating one from the other. The old man raised a part of the flooring, and got near one of the standards attached to the gas-main. A number of girls, having nothing to do, crowded round to watch the operations. The boy held the candle over the standard, and the escape was soon located. Ferguson, in his endeavour to remedy the defect, laid down his candle; but it is stated that he afterwards applied the flame to a standard in the centre of the floor. A tongue of fire immediately shot out, which, with great presence of mind, he extinguished. An accumulation of gaseous mixture had apparently collected in the flooring, for a tremendous report immediately ensued. The room was now completely dark, and following the report plaster, woodwork, bricks, and morter crashed down upon the occupants. The boy Cameron was killed instantaneously; Ferguson, who was upwards of 60 years of age, survived only a few moments; four girls and a lad were removed to the Infirmary; and eight girls and a salesman were taken in cabs to their homes. The injured were all progressing favourably when last reported upon. Considerable damage was done to property near the wrecked building.

EXPLOSION IN AN ELECTRIC MANHOLE IN BOSTON.

In our "Correspondence" columns to-day will be found a letter from Mr. W. R. Addicks, Chief Engineer of the Boston (U.S.A.) Gas Company, calling attention to the fact that electric cables occasionally cause explosions which are attributed to gas. The following are the particulars sent by him of an accident of this kind which occurred in Boston on the 14th ult., and was reported in the "Boston Journal" the next day: About half-past four in the afternoon, a

violent explosion took place in Merchants' Row, Boston. It was followed by a blinding flash of light; and then a column of flame appeared in the middle of the crowded street. The fire-alarm was quickly brought into use, and members of the brigade, accompanied by their extinguishing appliances, were soon on the spot. But as far as putting out the fire was concerned, they were powerless. It was found that a catch-box of the Edison Illuminating Company was ablaze; and the police and firemen did not appear to know whether the flames were caused by electricity, gas, or the ignition of the tarred coatings of the wires. The electricians thought it would be best to allow the fire to burn for a time before attempting to subdue it. Hundreds of people were attracted to the spot, and were with difficulty prevented from approaching dangerously near the flaming and sputtering column of fire, which was generally about 4 feet high and 3 feet wide, rising at times to 6 or 7 feet. It blazed away for an hour, looking like one of the natural gas or oil wells to be seen in some parts of Pennsylvania. By this time, however, it had somewhat died down; and then the electricians considered it would be a good thing to throw some mould or sand upon it, and smother it if possible. Sand was procured and shot into the hole; and by half-past five the fire was completely extinguished. The force of the explosion blew the manhole cover 20 feet into the air, and several pieces flew off, but fortunately without doing much personal injury. The accident did not cause the electric lights to go out in any of the buildings in the neighbourhood; it only made them a little unsteady. Considering the crowded condition of the thoroughfare at the time of the occurrence, it is surprising there were no serious casualties.

ELECTRIC LIGHTING NOTES.

It is estimated that the cost of the electric lighting installation for Skipton will be £15,000. The Council are among the applicants for Electric Lighting Orders in the next session.

The electric lighting works at Darlington, which are at present capable of supplying 7000 8-candle power lamps, and which have cost something like £26,000, have been duly inaugurated.

For extensions and contingencies in connection with their electric lighting works, the Llandudno District Council are applying to the Local Government Board for sanction to borrow £2713.

The Faversham Town Council are bringing their electric lighting ideas into shape. They have now resolved to erect a generating station, with a capacity equal to 5000 8-candle power lamps, and to apply to the Board of Trade for leave to spend £20,000 on the undertaking.

The Epsom District Council obtained a loan amounting to £16,100 for their electric lighting installation; but £2793 is now required to complete the work. Explanations on the subject were made to Mr. N. K. North, one of the Inspectors of the Local Government Board, at a recent inquiry.

The Rochester Corporation are looking into the question of purchasing so much of the undertaking of the Rochester, Chatham, and District Electric Light Company as is within the city. Terms have been named; but the Company are prepared to consider a modification. To this end, the Corporation have appointed a valuer.

The customers of the Fareham Electric Lighting Department have more than doubled since the works were started; but, notwithstanding, the expenses, including repayment of principal and interest on the loan, in the last financial year, exceeded the income by something like £200. This information was elicited by the Inspector at a recent Local Government Board inquiry into an application for permission to borrow £500, in addition to the £11,041 already sanctioned.

The Redditch Urban District Council have taken the unusual step of granting a special or supplementary rate, and a precept has been issued upon the Overseers for a supplementary rate of 1s. in the pound, payable on the 10th inst.; this being necessary to meet the deficiency on the electric lighting account. The rate is estimated to produce £1645, which about represents the amount of the deficiency. The expenditure upon the scheme so far is £20,000; and though it is claimed by its supporters that in a few years it will more than pay its way, so far there has been each year a deficiency.

Considerable progress was made in the work of the Electricity Department of the Manchester Corporation last year. In December, 1899, the number of consumers was 3014, with a demand equivalent to 328,696 8-candle lamps. There are now 3646 consumers, whose total demand of electric current for lighting and power purposes is equivalent to 362,464 8-candle lamps; representing an increase of 33,768 lamps. An installation of four 1800-kilowatt Westinghouse generators is in progress at Bloom Street; and when this is completed, the station will have a total capacity of 12,000-horse power, and will be rather larger than the Dickinson Street works.

Notice is given by the City of London Electric Lighting Company, Limited, that as from the dates when the meter readings for the December quarter are taken, "and until further notice by public advertisement," the rates for electric energy supplied by the Company for lighting purposes will be revised as follows: For the current consumed during the March and December quarters, up to and inclusive of the first six units per 8-candle lamp (or its equivalent), 8d. per unit will be charged; and for all current consumed in excess of six units, 2d. per unit. For the current consumed during the June and September quarters, up to and inclusive of the first three units per 8-candle lamp (or its equivalent), 8d. per unit will be charged; and for all current consumed in excess of three units, 2d. per unit.

The Ripon Corporation have definitely decided upon their course of action regarding electric lighting. The Electrical Engineers who were consulted (Messrs. G. Harrison and Co.) have drawn up two schemes. The first proposed the establishment of electrical works at the old pumping-station, at a capital outlay of £15,000. The second scheme submitted was that the Corporation should expend £5000 in the laying of mains and purchasing the electricity in bulk. As Messrs. Harrison and Co. are already established in Ripon, it was suggested that they should supply the electricity, and they offered to technically manage the undertaking at a charge of 5 per cent. on the annual income. The Council are going to adhere to the first scheme; and, consequently, they will apply for sanction to borrow the £15,000.

Judging from what transpired at the meeting of the Hastings Town Council a few days ago, there does not seem to be any necessity for the extension of the electric light mains which the Public Lighting Committee purpose carrying out at a cost of £276; and a protest against it was offered by Mr. Boutwood, who contended that the present was the wrong time for incurring this expense. He said it was a matter of common complaint that some people could not get enough current; and he thought this should be attended to before they extended the area of distribution. Mr. Allfrey, in reply, said if they had the current tested it would be found perfectly good, and perhaps something would be found wrong with the lamps. The majority of these lamps were warranted to last 1000 hours; but, as a matter of fact, they did not retain their efficiency for more than half the time. Another thing was that if the lamps were used longer than they should be they not only lost their efficiency, but registered more current. Mr. Boutwood thought this was not an adequate explanation. The Mayor interposed by saying Mr. Boutwood was out of order. The motion was then carried with three dissentients.

According to the Sydney correspondent of the "Daily Express," a colossal scheme for supplying the whole of Sydney with electro-motive power, not only for lighting, but for transportation and general motive purposes, is now being worked out by the Public Works Department. He says that for the generation of the necessary force, it is proposed to utilize the Blue Mountain rivers, and to provide for water storage on a large scale. In the wet season, it is estimated that 40 million gallons, or enough to keep the generating plant running at its utmost capacity for 150 days, can be stored without difficulty. The plant is to be of the most modern type, and is to be supplemented by storage batteries in order to fully utilize the available energy during the hours of least demand. For the Sydney train and tramway services alone some 25,000-horse power is required; and the scheme contemplates the generation of sufficient force to supply this, in addition to street lighting in the city and the mountain resorts, and the rental of electric power to manufacturers. The total cost of the scheme is under £1,500,000; and the working expenses, including interest charges, are put down at £158,000. The estimated annual income is £639,000; but little doubt is entertained that a net profit of £500,000 will be easily realized.

The Sleaford District Council electric lighting scheme was conceived, born, and will (there seems to be every indication) live under the most inauspicious conditions. Failure was never written more plainly over an electric lighting project than over this one. In the face of the grave and deeply rooted objection of the very people to whom the Council must look for custom to make the concern a paying one, they have stubbornly persisted in pursuing their own course, which bids fair to end in the saddling of the ratepayers with a practically insolvent concern, and a consequent rate-in-aid. And for what purpose? Merely to please about a dozen members of the local Tradesmen's Association, whose luxurious tastes have over-run the bounds of discretion. The exalted councillors did not deign to consult their fellow ratepayers before going far into the matter; but at the Local Government Board inquiry into their application for the necessary money to start the undertaking, the opposition was represented by no less than three-fourths of the assessment of the district. Yet in face of this, the Local Government Board have given their sanction to the borrowing of the £7000 asked for, but have only granted 25 years for repayment, instead of the 30 years requested. People in a position to judge foresee many calls upon the ratepayers for this piece of extravagance; and, if this proves true, they must look to it that the disgrace falls in the proper quarters.

We well remember, when the question of electric lighting was under discussion at Redditch, success was foreshadowed in the most glowing terms. The actual results so far have not justified these predictions; on the contrary, those members of the Local Authority who were the most active in shouldering the scheme into existence must to-day feel very small before the ratepayers. To meet the deficiency on the undertaking, the District Council, on the 21st ult., issued a precept upon the Overseers for a supplementary rate of 1s. in the pound, payable on Jan. 10. The rate is estimated to produce £1645, which about represents the amount of the deficiency. The sum expended upon the scheme so far is £20,000; and it is now claimed by its supporters that "in a few years" the scheme will more than pay its way. So far there has been each year a deficiency, due, it is said, to the repayment of principal and the provision of interest. Of course, the promoters knew, before embarking upon the undertaking, that money would have to be found for these purposes; but the ratepayers would have been a little less willing to give their consent to the scheme had they seen any indication of the annual deficiencies and the supplementary rate on the horizon. Other towns of the size and position of Redditch may profit from the experience of the ratepayers of that town; and, if they do, then the Redditch ratepayers may comfort themselves that they have not altogether lived in vain.

A discussion took place at the last meeting of the Hampton District Council on a motion to apply to the Board of Trade for a Provisional Order authorizing the Council to supply electricity for public and private lighting and other purposes within their area. The principal speaker was the Chairman (Mr. G. Sanders, J.P.), who expressed the opinion that the electric lighting of the town, which, although interested in gas, he said he should be pleased to see, should not be carried out at the expense of the ratepayers. His advice was that they should let a company come in and "burn their fingers." He quoted the case of Kingston to show that electric lighting schemes generally cost three times as much as the original estimate. He also said that in Liverpool and Berlin they were abandoning electric light and returning to gas because it was much cheaper. Another instance cited in support of his view was the recent decision of the Kingston Board of Guardians to continue with gas, because they had found that while the cost would be only £856 15s. 9d. per annum, an installation of electricity by themselves would amount to £1315 1s. 6d., and if supplied by the Corporation £1687 18s. 1d. If they adopted a scheme for themselves, it would land them in an annual deficit of £2000; and certainly he should decline to be a consenting party to it. Notwithstanding the Chairman's arguments, the Council came to the conclusion that the

best interests of the district would be served by obtaining an Order and having the control of the matter in their own hands; and on the motion being put to the vote, it was adopted—the Chairman being the only dissentient.

Once more Mr. Charles F. Botley, Assoc.M.Inst.C.E., Assistant Gas Engineer and Electrical Engineer to the Hastings and St. Leonards Gas Company, has done good service by putting before the Company's employees, most of whom are ratepayers, a few plain facts in regard to the comparative cost of gas and electricity. He has chosen the present time for so doing because, on and after to-day, the main thoroughfares of the town are to be illuminated with electric arc lamps up till eleven or twelve o'clock at night, after which time 16-candle glow lamps will be brought into use. Under this arrangement, a ridiculously small quantity of light will be furnished when really more is required for the public safety. The charge for these arc lamps is understood to be £14 or £15 apiece per annum; but Mr. Botley thinks it will be more like £30, as the figure charged to the ratepayers for similar lamps on the Front is £50; and either this is too high or the other is a great deal too low. At all events, the Gas Company could have provided equal illumination for the thoroughfares in question at much less cost. It appears that the Corporation are using an arc lamp for every gas-lamp displaced—in other words, spending £30 in place of £6, and getting actually less light after midnight. While they supply current to the private consumers at less than cost price, they make up the deficit by charging exorbitantly for the Front lamps. Mr. Botley points out to the employees that every 1000 cubic feet of gas consumed means the direct contribution of about 3d. (owing to the town dues on the coal) to the local rates; whereas the possession of the electric light works by the town cost the ratepayers practically a rate of 1d. in the pound in the last financial year. Here is indeed matter on which not only the parties addressed, but the whole of the ratepayers, may well reflect.

Tapping gas service-pipes and removing gas for consumption, without any intermediary interference on the part of a meter, is an act with which readers are only too well acquainted; but such doings have been little heard of in connection with electricity supplies. A case, or rather a supposed case, has come from Liverpool. Mr. Edwin Isherwood, an electrician of that city, was charged a few days since with an offence of the kind. According to the Deputy Town Clerk (Mr. E. Pierce), defendant has been a consumer of electricity for some time; but, in the early part of the year, it was observed that the quantity of current used was not so great as would be expected from the number of lights on the premises. The meter was examined on several occasions and it was fancied that there was something wrong with it, but it was found to be in order. Other inquiries led to the belief that defendant had been abstracting the electric current by an ingenious trick. This was done by making a connection with the wire supplying the meter. By this means the current was diverted from the meter, and was not therefore registered. Albert Addison Lake, a youth who was in the employ of the defendant from March to November, alleged that about a fortnight after entering his service, he saw Isherwood connect a piece of wire to the electric supply so as to take the current away from the meter. Witness further alleged that Isherwood had said to him that the meter registered too much, or the Corporation charged too much, and he (Isherwood) did not think there was anything wrong in "taking it out of them." Mr. Alfred Clough, Assistant Electrical Engineer to the Corporation, had examined the meter, and stated there was reason to suspect that the quantity of electricity which appeared to be consumed was not exact. Mr. Quilliam, who appeared for the defendant, entered into a long statement, pointing out that the witness Lake was a discharged servant, and that he had simply concocted his story out of spite. Mr. Quilliam dealt in detail with the units consumed by defendant during the year, in order to account for the rise and fall upon which the summons was to some extent based. In those months giving a comparatively low consumption, defendant's establishment had been closed part of the time. In March, when Lake said he saw Isherwood tampering with the meter, the consumption was only one unit less than it was in January, though March was a much lighter month. Defendant denied absolutely that he had used the fraudulent methods referred to. After considering the evidence, the Magistrates announced that they were equally divided, and in order to have a third Magistrate present, the case was adjourned for a fortnight.

LIVERPOOL'S NEW RESERVOIR AT PRESCOT.

As the last issue of the "JOURNAL" was going to press, Lord Derby was performing the ceremony of cutting the first sod of an additional reservoir at Prescot, in connection with the Liverpool Corporation water supply. The land on which the reservoir is being constructed was acquired from his Lordship, and is adjacent to the present reservoirs. The function was witnessed by members of the Corporation Water Committee and others. Before calling upon Lord Derby to accomplish the duty he had kindly undertaken, Alderman Burgess, the Chairman of the Water Committee, briefly explained the necessity which existed for the construction of this reservoir, which would involve considerable expense. Among other points, he laid stress on the fact that the new reservoir would not add to the Corporation's resources, but that it was essential for the maintenance of a reasonably sufficient reserve to enable them to continue the water supply to Liverpool during operations that must from time to time be undertaken on the aqueducts. The capacity of the present reservoirs at Prescot was equal to 87½ million gallons; but they could, in fact, draw off for use in Liverpool only about 60 million gallons. They were advised by their Water Engineer that this storage accommodation was utterly inadequate for the two long lines of pipes from Vyrnwy and Rivington; and even the storage now contemplated was very much smaller than their neighbours in Manchester possessed. The new reservoir would cover more than 34 acres of land; and the top water area, which was 276 feet above the mean sea-level, would be about 38 acres. The length of the embankment, the greatest height of which would be 31 feet, would be about five-sixths of a mile. The minimum depth of water in the reservoir would be 15½ feet; and it would be capable of storing something like 110 million gallons of water. He was glad to say that the reservoir was being constructed by a Liverpool firm (Holme and King). In concluding his remarks, he asked his Lordship to accept from the Water Committee a spade, which was a handsome specimen of the silversmiths' art. Lord Derby entered into the function with good-natured zest, divesting himself of both over and under coats in order to efficiently perform the "job." He afterwards addressed those present at some length; and the ceremony ended with a vote of thanks to his Lordship.

LITTLEHAMPTON WATER SUPPLY.

Projected New Works.

At the Littlehampton Town Offices, Mr. B. H. Bicknell recently held an inquiry on behalf of the Local Government Board into an application made by the Urban District Council for power to borrow £16,630 for purposes of water supply, including the construction of works at Lyminster and Warningcamp, within the rural district of East Preston. Mr. Howard, the Surveyor, stated that the maximum yield of the two existing wells was about 140,000 gallons per day; but in the summer time there was a falling off to the extent of probably 20,000 gallons. It was considered necessary that there should be furnished an average of 24 gallons per head of the population daily. But the supply last spring worked out at 22½ gallons; and in the summer, when the influx of visitors doubled the normal population, the average fell to only 10 gallons. An arrangement was made with the Duke of Norfolk by which for two summers the Council had been able to receive an auxiliary supply of 100,000 gallons per day from Arundel, and the town was still getting 20,000 gallons a day. In order to carry out this arrangement, the Duke gave £3000 towards laying the necessary mains; the balance, £448, being raised on loan. With regard to the new scheme, an excellent supply of pure water had been found at Warningcamp, where an artesian well was sunk last spring to a depth of 145 feet. A continuous test for 14 days was afterwards made, with the result that 25,000 gallons of water per hour was raised. The well now proposed would be 9 ft. 6 in. in diameter and 57 feet deep. It was intended to have duplicate sets of 25-horse power duplex triple-expansion engines, each capable of raising 500 gallons per minute to a height of about 135 feet. The water would be pumped into a reservoir capable of holding 500,000 gallons.

At the close of the inquiry, the Inspector expressed his intention of visiting the site of the proposed well.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Before these observations appear in print, the year will have passed away, and not only a new year, but a new century, will have begun to run. The closing year of the century which saw, not the discovery of coal gas, but its rise into one of the greatest commercial undertakings of the time, has also seen the fall of Scotch gas from the position of distinction which it took from the outset, and has held ever since, in the matter of high illuminating power. The merits or demerits of gas of high light-giving quality are not suitable for discussion here; but it is the fact that, for the first time in the history of gas supply, it has been proposed by several Corporations in Scotland to obtain authority for reducing below 20 candles the illuminating power of the gas supplied. This significant change is of more importance than is at first sight apparent. Gas supply is quite a modern convenience. A hundred years compasses its whole existence; yet at the end of its first century it is proposed to lower the standard of the article. The question is forcibly suggested as to what, at the end of its second century, will be the position of the gas industry. It does not require much of the prophetic faculty to be able to say that there will then be a demand for gas, and a means of supplying it; for there is no instance on record of mankind having to give up its knowledge of great scientific principles, or its facility for handling mechanical methods of production, or relinquishing its craving for a commodity which has proved itself to be so useful as to be almost a necessity. There will, of course, be many changes in gas supply before the period referred to is reached. If these should come as the evolution of events, brought about by the learning and skill of gas engineers, they will be welcome, because every change of this description will tend to strengthen the position of the industry. If changes should be forced upon gas engineers by exhaustion of the raw materials, doubtless they would be unwelcome, as this lowering of the illuminating power in Scotland will be to many consumers. But, in the result, it cannot be doubted that means would be found for obtaining gas from substances yet undreamt of; and in that view, what at first might appear to be a set-back of the gas industry would be but a temporary derangement, leading to permanent advantage. Who can say that he may not live to see the stones beneath his feet treated by chemical or mechanical means, or both, so as to produce gas for illuminating purposes? As great wonders have been witnessed. This is, however, a flight of imagination. Returning from it, it is satisfactory to note that, apart from this matter of the threatened exhaustion of cannel coal, there is not only no other element within the horizon of gas production and supply which is, in any sense, of a detrimental nature, but, on the contrary, in all departments—men, supplies, plants, and methods of manufacture and combustion—the gas industry was never better equipped, or more fit to occupy its position in the world. The counterpart is happily also equally true, that there never was a greater demand for the chief product of gas-works.

Scotland does not stand singular in the matter of the price of coal, which has been so high during the year. It is a question of the first importance to gas producers. There is a general consensus of opinion that we may now look upon the situation with a greater degree of equanimity. The masters and men have had their combine, and they have failed. Coal is returning to a normal price; and in this there is hope for the gas manufacturer.

Perhaps the feature for which the past year will be most remembered

will be the large number of changes which have taken place in the *personnel* of the body of Managers. There have been changes at Auchterarder, Brechin, Broughty Ferry, Callander, Dunfermline, Forfar, Greenock, Hamilton, Kirkintilloch, Kirriemuir, Lanark, Maybole, Melrose, Perth, Rothesay, Selkirk, Renton, Strathaven, Tranent, Troon, West Calder, and Whitburn—about 10 per cent. of the whole number of gas managers in Scotland. It is a satisfaction to know that these changes have been almost entirely due to transfers to better positions, and not to any extent to removals by death, of which there have been very few instances during the year.

That the matter of the provision of Granton House as a residence for Mr. W. R. Herring, the Engineer to the Edinburgh and Leith Gas Commission, which was brought up at a meeting of the Edinburgh Trades Council recently, had something to do with an agitation among the men in the gas-works, was foreshadowed in the remarks which were made. There has since been confirmation of the fact, in the shape of a meeting of gas workers in Edinburgh and Leith, which was held last Saturday week, under the auspices of the Gas Workers and General Labourers' Union. It is significant of the want of spontaneity on the part of the workers in this movement, that the chair was taken by a journeyman baker. The attendance is said to have been between 70 and 80 men; but it would be a bold assumption to take for granted that all the auditory were gas workers. Possibly the greater number were "general labourers." The Chairman explained that the object of their meeting was to discuss the questions of overtime and Sunday labour in their relation to wages. It seemed that Sunday labour was a necessity in their particular industry; and if it was a necessity, it was the duty of the public to see that the gas workers were properly remunerated. Sunday labour must be paid for as double time, just as it was in other trades. Mr. W. Blackwood, the Scottish District Secretary of the Union, was present, and addressed the meeting. If, he said, there was to be a fight between the gas workers of Edinburgh and Leith and the Gas Commission, then they would fight to the bitter end. Never yet had the Union failed to fulfil its obligations to the members, and never had men come out on strike without receiving the full strike pay of 10s. a week. He was confident that if only the men showed a bold front, the Gas Commissioners would concede the demands. All the corporations of Scotland who had the gas supply under their control looked to Edinburgh for a lead in the matter of wages. If the men in Edinburgh and Leith were successful in their demands, other gas workers over Scotland would become members of the Union, and would obtain the same advantages. He hoped the Commission would recognize that the men were now exasperated, and that their desire was to have the demands conceded with as little friction as possible. A resolution was adopted by the meeting calling upon the Executive Committee of the Scottish Branch of the Union to allow a definite time to the Gas Commission in which to give a satisfactory reply to the petition of the men submitted to them in October last, and expressing regret at the dilatory manner in which the Commission had dealt with the representation made to them by the men. Just so. The Union began their business in Glasgow, which they must have thought then to be the plan to give Scotland a lead in gas matters. They were foiled there, most effectually; and the local Secretary has since discovered that the lead must come from Edinburgh. But if the lead is to come from the Gas Commissioners in Edinburgh, it is evident that the workmen in the employ of the Commissioners are not the parties who are to take the initiative in the leading; for the resolution adopted was that the Executive should lay down the law to the Commissioners. It is thus an exotic agitation I anticipate that the Commissioners will have no difficulty in taking the lead, and that their men will follow them, to the exclusion of this assertive Union. If matters go as they should, the lead will not be in the direction sought by the Chairman and the Union representative, but in the opposite direction. Already the Trades formed have had proof of their fallibility in this matter; for, their last resolution having been sent to the Town Clerk, they have received a reply to the effect that the doings of the Gas Commissioners are not subject to the review of the Town Council. The Clerk to the Gas Commissioners (Mr. J. M'G. Jack) has replied that the subject will be laid before the Commissioners at their next meeting; and there the matter rests.

On Monday a special meeting of the Edinburgh and Leith Gas Commissioners was held, for the purpose of disposing of the application of the men in the gas-works for higher wages. I was not present; but I give the information as to what took place on the high authority of the "Scotsman," which is to the effect that the Commissioners instructed the Works Committee to receive a deputation from the Gas Workers' Union on the subject. I hope this is not a correct statement of what was done, because, if it be, the Edinburgh and Leith Gas Commissioners will be at once placed at the top of the list (at present a somewhat nebulous one) of those bodies who have recognized the Union. From this first step, it is not a great stride to the situation of the Union virtually directing the gas-works, and instructing their Executive to receive a deputation of the Gas Commissioners upon a proposal to effect some improvement in the works. I would fain hope that the Commissioners have not given themselves over bound to the Union, the amount of whose compassionate regard for all who do not belong to their body is quite well enough known generally, and must be known to the Commissioners.

The Forfar Gas Corporation are not yet a body of one mind, though they have a new Manager. At the same time, the latest development in the Corporation is a puzzle to me. The Gas Committee, at a meeting last week, recommended that Messrs. Briggs and Co., of Dundee, the contractors for the residual products at the gas-works, should, without prejudice, be allowed a reduction of £20 upon their account. I do not know why the reduction was proposed; and I am more at a loss to understand why the Corporation should have been urged to agree to it by Mr. Christie. Mr. Christie, during all the time that Mr. Forbes Waddell was Manager, was the foremost advocate in the ranks of those who professed that the gas-works should pay better than they were doing. Any such proposal as the reduction of a contract account would have been exposed with scatheless criticism. Mr. Christie was reminded of some former expressions of his upon the subject, and in reply said that he took up the position he had done in order to relieve the Committee from an evident difficulty. The firm, he was of opinion, had a monopoly of the trade; and unless they conceded something, they might have difficulty in disposing of their residuals. The recommendation of the Committee was agreed to. It would be unfair to question Mr. Christie's *bona fides* in this matter; but it is not going too far to dispute his remark as to a monopoly of the business. There is no monopoly, in reality. If Messrs. Briggs do not take the residuals at contract price, there are other firms who would buy them, on terms; and the better policy would have been to have asked the Committee to find out what others would offer for the residuals, rather than accept the conditions of contractors whose advocate describes them as monopolists.

Broughty Ferry bids fair to come into the foremost place among gas undertakings in Scotland, in the matter of economical working and the adaptation of means towards the attainment of that object. The latest movement in this direction is the novel one of the introduction of the electric light into the gas-works. All the departments in the works, with the exception of the retort-house, have been lighted by electricity—even the ground surrounding the gasholders. The dynamo which produces the current is placed in the engine-house, and is worked by plant already existing, so that the introduction of electricity has cost comparatively little; the total expenditure amounting to about £50. The house in which the new benzol plant has been erected, the meter-house, and the large apartment in which the purifiers are situated have been equipped with the new illuminant; and in the last-mentioned place it should prove particularly serviceable. Here it was possible hitherto only to work in daylight, it being considered dangerous to introduce an exposed light into the atmosphere; but now operations can be carried on with perfect safety by artificial light. The work was carried out under the superintendence of Mr. Forbes Waddell, the Gas Manager. The installation was inaugurated on Monday night, in the presence of a number of the Burgh Commissioners and others. Provost Gray proposed the toast of "Success to the New Plant." He remarked that many of them would have noticed considerable changes and improvements at the gas-works during the past few years; and the last was, in some respects, as important as any of the others, because it ensured greater safety to the workers and the plant itself. Bailie Christie said it had always been his aim to provide the gas-works with all modern requirements. He had only to ventilate this latest idea, and the Commissioners, in keeping with their forward policy, readily agreed to the proposal. He felt certain it would be a success. It removed any difficulty they might have experienced in working the benzol plant, and would prove an effective safeguard for the workers. Mr. Waddell, with whose name the toast was also associated, subsequently returned thanks; remarking that the cost of the electric light would be less even than that of gas.

A great gale swept over Scotland, particularly the central part, on the night between Thursday and Friday of last week. I was at the time writing my "Notes" for the last number of the "JOURNAL," and was fully conscious of the fury of the blast. On looking out, I saw that, of about twenty gas-lamps which are visible from my window, only two remained alight. I do not remember ever seeing such a wholesale extinguishing of street-lamps by wind. The electric arc lamps fared badly too. The lanterns were swung about until, in some instances, they struck against the lamp-posts (they are on the bracket system), and were smashed, when, of course, the carbon soon sputtered away and the street was left in darkness. I see it reported that so many gas-lamps were blown out in Kirkcaldy that the town was practically in darkness during the storm. I have been making inquiries as to whether there had been trouble with gasholders, but have heard of none except what is published regarding a new holder at Denny. The holder is all but completed, and was filled with gas. The gale caused the swan-necks of the upper lift to slip, and, the lift tilting, the gas was lost. It was still in the hands of the Contractors (the Barrowfield Iron-Works, Limited, of Glasgow). One manager I met told me that he stopped retorting during the gale, in order to keep his holder down. Doubtless others have done the same. That holders have withstood the wind as they have done, is most gratifying, and particularly so when the great force of the gale is considered. The Astronomer Royal for Scotland has announced that some blasts reached the enormous velocity of 120 miles an hour. The velocity of the gale which blew down the Tay Bridge was little over 90 miles an hour.

At a meeting of the Commissioners of Falkirk last week, Mr. Andrew Gillespie, of Glasgow, was appointed Consulting Engineer upon the question of the site for the new gas-works.

The first section of the new gas-works at Perth are being worked, but have not yet been formally opened. The effort was to get them ready for the heavy winter consumption; and this has, by dint of hard work, been accomplished.

The Rating of Reservoirs.—Reference was made to this question, at the last meeting of the Hampton District Council, by Mr. Aldbless, who inquired what had been done in regard thereto. He said he understood the Local Government Board intended to bring in a Bill upon the subject; and he thought it would be well if they could get a powerful deputation of members of Parliament and County Councils to interview the Board, and have clauses drafted for the protection of their interests. It was decided to communicate with Mr. Scott, of Sunbury, the Secretary of the Association of Local Authorities who have taken up the matter, who, it is stated, has received numerous promises of support.

Gas-Mains Extensions at Leeds.—About three years ago, Mr. Walter Hole, of Rochester, obtained the appointment of Superintendent of Gas-Mains and the Distribution Department to the Leeds Corporation. Since that time he has planned and carried out a considerable extension of the trunk main system; laying something like 60 miles of new pipes, in addition to enlarging others. The work, which has involved an expenditure of more than £70,000, forms part of a general scheme costing £120,000 which he presented to his Committee shortly after he went to Leeds, and which will cover a period of five years. Among the unique pieces of work which he has accomplished is the carrying of a 36-inch steel main to the Great Northern Railway subway in Wellington Road, and outside the Canal Bridge and Wellington Bridge, across the River Aire. This undertaking involved many difficulties, which have been successfully surmounted. In recognition of his efficient services, the Gas Committee have unanimously decided to recommend the Council to raise his salary by £100 per annum.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 29.

Sulphate of Ammonia.—The business of the week has been somewhat interfered with by the holidays, and values are barely maintained; the closing quotations being £10 15s. to £10 18s. 9d. per ton, delivered f.o.b. at the ports. Supplies have been rather more abundant; many producers being desirous of placing their makes up to the end of the year. Direct business has been small; buyers being fairly well supplied, and rather disposed to play a waiting game. In forward, £11 5s. per ton is reported to have been paid for delivery up to September. For the spring months, the makers are firm at £11 7s. 6d. per ton; but buyers will not pay the price, and meantime are contenting themselves with January, which can be bought from speculators at about the level of spot prices. For February, there are sellers at £11 5s. per ton f.o.b.

Nitrate of Soda is steady at 8s. 3d. to 8s. 6d. per cwt., according to quality.

LONDON, *Dec.* 29.

Tar Products.—There has been an almost complete cessation of business transactions during the week, owing to the holidays. Tar distillers are complaining of accumulating stocks, particularly of creosote oil, which continues practically unsaleable at anything like reasonable prices. Many producers are now burning the oil either under their stills, or in their steam-boilers. In this direction, it may be estimated that 1 ton of oil is equal to at least 2 tons of best coal; and at to-day's prices, liquid fuel should be the cheaper article to use. Benzols are a little firmer, although there is no great demand for forward delivery. Naphthalene is steady; naphthas are moderately strong; pitch, if anything, is slightly improved in tone; but, generally speaking, the markets are disappointing.

Prices are as follows: Tar, 14s. to 18s. Pitch, east coast, 30s. to 33s., according to port; west coast, 28s. to 30s. Benzol, 90's, 10d. to 1s.; 50's, 1s. 1d. Toluol, 1s. 3d. Solvent naphtha, 1s. 1½d. Crude naphtha, 4½d. Heavy naphtha, 1s. Creosote, nominal, 1½d. Heavy oils, 2½d. Carbolic, 60's, 2s. 5d. Naphthalene, 90s.; salts, 6os. Anthracene, "A," 3½d.; "B," 2d.

Sulphate of Ammonia shows signs of weakness. Buyers are hanging off; and there appears an indication in one direction at least of efforts to "bear" prices. Very little new business is reported; and those sales that have been made will not average more than £10 16s. 3d. per ton, less 3½ per cent., at all ports.

LANCASHIRE COAL TRADE IN 1900.

Notwithstanding the collapse that has come over the iron and steel trades, and the unmistakable signs in many directions of slackening industrial activity, the coal trade of Lancashire remains in a generally strong position, which is in marked contrast with the depression in some of the large coal-using industries. This somewhat abnormal situation is, however, not difficult to explain. The absence of stocks at the collieries has all through been the main cause of the rapid advance in the price of every description of fuel, and is still the chief factor in the situation that is operating against any present material downward move. In fact, the initial stages that have brought about the present high prices date as far back as the prolonged miners' dispute in South Wales, when the coal supplies of Lancashire and other mining centres were so largely drawn upon that the usual stocks held at collieries were completely cleared away, and in reality have not since been replaced. Under ordinary conditions, the depletion of stocks during the period of the South Wales strike would not have been seriously felt; but the general industrial revival which immediately followed, and which until well on in the past year has steadily increased, came upon the coalowners when, to meet the requirements of their customers, they had to rely almost absolutely upon the output of their pits. The result has been that they have never been able to overtake the demand, the pressure of which has gone on increasing, while coalowners have not been in a position to correspondingly increase the production of the collieries. Indeed, their position as to supplies to cope with the demand has been persistently going from bad to worse. The culmination of this scarcity of supplies and continuous upward move in prices would, however, seem to have been reached during the past twelve months. Early in the year, it was very evident that a strong advance in prices was inevitable. Both inland requirements for iron-making, steam, and general manufacturing purposes, and the altogether exceptional demand for shipment, were over-taxing all the resources of the collieries, which, having no stock to fall back upon, could only rely upon the daily output of the pits; and in many quarters it was reported that this was being seriously restricted by the action of the miners. Naturally, all large users of fuel became anxious about their forward supplies; and the customary twelve months' contracts were pushed on for settlement much earlier in the year than usual. When renewals of contracts for steam and forge coals over the ensuing twelve months came forward, coalowners at once insisted upon an advance of 5s. per ton over the previous year's prices; and later on, after their position had been so completely established by the terms on which the gas coal and locomotive fuel contracts were settled, advances of 6s. per ton were held out for, bringing the average basis to about 13s. 6d. and 14s. per ton at the pit. When the gas coal contracts came upon the market, it was very soon found that the coalowners had taken up a position which meant that practically they were determined to dictate their own terms, not only as to price, but also as to the conditions on which they would contract. As in the previous year, when a general sort of arrangement between Lancashire and Yorkshire was made, negotiations had been going on between leading coalowners representing the two districts named, as to some uniform basis of action which would obviate any risk of unnecessary competition. A general understanding was come to, and arrangements with regard to various districts arrived at, which safeguarded Lancashire and Yorkshire coalowners from any cutting in prices which otherwise might have been unwittingly entered into. There was also a general revision of the contract terms; clauses which in previous years had been regarded as objectionable were struck out, and others introduced in the interests of the coalowners. Among these was the stipulation that 40 per cent. of the contract quantities must be delivered during the summer months; and in the event of this 40 per cent. not being taken during the summer, not more than 60 per cent. of the contract quantities would be delivered during the winter. As to prices, these were to be 50 per cent. above the 1899 rates. The basis on which previous contracts had been placed averaged about 9s. to 9s. 3d. per ton at the pit for the lower qualities, and 9s. 6d. to 10s. for the better descriptions of gas coal—representing an advance of 1s. 6d. to 2s. per ton over the 1898 rates. After several separate and joint meetings of the Lancashire and Yorkshire coalowners had been held in order to decide upon a basis for the year's contracts, an understanding was come to that in no case were tenders for gas coal to be sent in except at an advance of 5s. over the 1899 prices. Under the then exceptional conditions of the coal trade, users of gas coal had practically no option but to submit to the dictation of the coalowners; and not only were contracts settled much more promptly than is usually the case, when negotiations as to prices are possible, but as a rule consumers bought to cover their full requirements—preferring not to run any risk of being compelled to purchase in the open market at possibly much higher rates. Ultimately the contracts for gas coal were settled on a general basis of 13s. 6d. to 14s. per ton at the pit for good medium sorts, and 14s. 6d. and 15s. for the better qualities of screened gas coal. The railway companies had also to face a very similar position, and on their renewal contracts for locomotive fuel had to submit to an advance of 5s. per ton over 1899; the general basis for locomotive fuel being 13s. per ton at the pit. On slack there has been a very large advance, owing in some measure to the extra requirements for coke-making purposes, and prices during the past twelve months have touched a point which represents an advance of quite 200 per cent. over the rates ruling until a very few years back; the minimum quotations getting up to 10s. 6d. per ton at the pit, with the better qualities of slack quoted at 11s. to 11s. 6d. In the common qualities of round coal for steam and forge purposes, and which to some extent regulate gas coal prices, there has towards the close of the year been some slight easing down upon the maximum quotations; 12s. to 12s. 6d. per ton at the pit representing about the average figures. These prices, though they are being obtained without difficulty on sales for current requirements, and collieries have no surplus to offer in the market, do not represent a basis upon which forward contracts are meanwhile possible. Present indications are that current rates may possibly be fairly well maintained until towards the end of the first quarter of the New Year. The crucial test will come after the close of winter, and when the usual renewals of contracts for gas-making purposes and railway requirements are brought upon the market. There is already evidence that coalowners will find a very substantial re-arrangement of their prices necessary before buyers will place contracts for anything like quantities; but as to what concessions in prices will be obtainable, it is as yet altogether too early to at all anticipate. The position is much the same as regards slack, except that for this class of fuel prices have not given way to any appreciable extent; but the large users are holding back from the settlement of the contracts which usually have been placed earlier in the year, and negotiations are going on as to the basis on which they are to obtain their supplies. The exceptional activity in the iron trade, which was maintained pretty well over the first half of the year, has necessarily entailed large requirements for coke, and as a consequence has forced up the price of this class of fuel. Furnace cokes, which started the year at 19s. to 20s. per ton, advanced to about 24s. 6d. to 25s. at the ovens; but during the latter part of the year they have steadily receded in price, until at the close the basis was about 15s. Foundry cokes rose from about 25s. to 25s. 6d. per ton at the opening of the year, to 31s. to 32s. as the maximum, and have not receded more than about 2s. per ton from top prices.

COAL TRADE REPORTS.

From Our Own Correspondents.

Northern Coal Trade.—The northern coal trade has been of necessity influenced by the holidays, which have lessened both the production and the consumption of fuel. In the steam coal trade, best Northumbrian kinds are quiet at from 13s. 9d. to 14s. per ton f.o.b., second-class steams are from 13s. to 13s. 6d., and steam smalls are from 7s. to 7s. 3d. Large contracts for locomotive coals for the chief local railway have been concluded at about 12s. per ton f.o.r. over next year. In the gas coal trade, the demand is fairly steady for this season; but there is a good supply, which rather lightens the pressure, though the deliveries are now at the highest point. Best Durham gas coals are quoted at from 13s. 3d. to 14s. per ton in the market; but the contracts that are being delivered are from 2s. to 2s. 6d. above this price, f.o.b. In coke, a better demand for blast-furnace qualities is experienced, though the prices have not varied. For export coke, from 20s. 6d. to 22s. per ton f.o.b. is the current quotation. Gas coke is rather irregular; many of the contracts being near completion, while the output is heavier. Quotations vary a little more; and perhaps about 23s. per ton f.o.b. is the average for the week.

Scotch Coal Trade.—With the fall in prices, there is now more demand for coal, which is what was to be expected. The miners were last week in conference in Edinburgh, and adopted, by a majority, a resolution in favour of a five-day week. The subject of wages was not under discussion, except in so far as the President ridiculed the notion of wages being reduced on account of prices having fallen; his idea being that employers have been making fortunes from the extra price of coal. There was much talk about the restriction of the output, in order to keep up wages. It was also subject of remark that the miners were well organized at present. Any further reduction in prices may, consequently, lead to trouble with the miners. The prices quoted are: Main 10s. 6d. to 10s. 9d. per ton f.o.b. Glasgow, ell 11s. 6d. to 12s. 6d., and splint 12s. 6d. to 13s. The shipments for the week amounted to 179,603 tons—a decrease of 4602 tons upon the previous week, and of 1718 tons upon the corresponding week of last year. One week's figures have still to come in; but for the year to date the total shipments have been 10,718,475 tons—an increase of 1,958,734 tons upon the corresponding period of last year.

Fire at the Hartlepool Gas-Works.—About six o'clock last Friday evening, a fire broke out in the sulphate-house at the works of the Hartlepool Gas and Water Company; and in a very short time, owing to the strong wind blowing, the entire house was in flames, and the roof fell in. On the arrival of the fire brigade and two engines from the North-Eastern Railway Company, it was found quite impossible to save the building; and the efforts of the firemen were accordingly directed to preventing the fire from spreading to the adjacent retort-house. In this they were successful. Mr. T. Bower, the Engineer and Manager, and other officials, were present, and rendered valuable assistance to the firemen. Considerable anxiety was felt for the safety of a large gasholder in close proximity to the burning building; but fortunately the wind carried the flames away from both the holder and the retort-house. The fire was difficult to subdue; but it was practically extinguished by seven o'clock.

Gas and Electricity Both Popular at Bolton.—The Chairman of the Gas Committee of the Bolton Corporation (Alderman Miles) says that, owing to the rapid growth in the consumption of gas, it will be necessary before long to put up a new gasholder. The increase since last March has been 32 million cubic feet, or 7 per cent. The probable cause of this is the large number of gas-stoves used in this thriving Lancashire town. Nearly every house has something, if only a small breakfast griller. According to the Superintendent of the Corporation Gas-Fittings Department, no big cookers are now let out on hire (except a few old ones). They are all sold to tenants—either cash down or by 25 quarterly payments. Both gas and electricity are being used very extensively in Bolton; but the plant of the latter illuminant occasionally plays a prank, and only a few evenings ago the staff at the electricity works found themselves in a dilemma. The current was insufficient to provide both light for the town and motive power for the tram service which has now been in existence about a year; and the consequence was that the trams were stopped. As it was a pouring wet night, the would-be riders were not very pleased.

New Joint-Stock Companies.—The Atmospheric Gas Company, Limited, has been registered with a capital of £20,000, in £1 shares, to acquire from J. E. Whiting and J. Gordon certain patents for "improvements in the method of, and apparatus for, manufacturing an improved gas for obtaining light, heat, and power, for producing mixtures of vaporized oil and air for heating, lighting, and motor power, and for apparatus for applying and distributing such gas for any purpose." The Bawtry Gas Company, Limited, has been formed with a capital of £2000, in £1 shares, to take over the business of the Bawtry Gas Company; to adopt an agreement with W. Pearson and J. Harrison (Directors of the Company); and to carry on the business of gas makers, coke, coal tar, pitch, and ammoniacal liquor manufacturers and merchants, &c. The Doune Lighting Company, Limited, has lately been registered in Edinburgh, with a capital of £1000, in 10s. shares, to supply Doune, Perthshire, with gas. The General Incandescent Company, Limited, with a capital of £1000, in £1 shares, will carry on the business of incandescent lighting and heating appliance, lamp, and mantle makers and chemical manufacturers, &c.

Increase in Price by the Tottenham and Edmonton Gas Company.—The Directors of this Company have given notice that the selling price of gas by ordinary meters will be increased to 3s. 4d. per 1000 cubic feet from the reading of the indices for the Christmas quarter, and that the quantity of gas supplied by the prepayment meters will be reduced to 20 cubic feet for 1d. This represents a rise of 4d. per 1000 feet in the former, and of 4½d. per 1000 feet in the latter case. Notwithstanding the abnormal increase in the price of coal, oil, &c., the Directors refrained from raising the charge for gas until the end of the past year; and, unless unforeseen circumstances arise, the advanced rates will not be continued for more than twelve months.

Christmastide Gas Consumption in Manchester.—The largest gas consumption in Manchester on any one day in 1899 occurred on the 27th of December, when the total reached 25,900,000 cubic feet. The quantity burnt last Thursday—the corresponding day of the past year—was only 14,329,000 cubic feet, or a decrease of 11,571,000 cubic feet. For the week ending Dec. 28, 1899, the returns showed a consumption of 130,000,000 cubic feet of gas; while for the corresponding week last year the figures are 117,728,000 cubic feet—showing a falling off of 12,272,000 cubic feet for the week. The decrease is accounted for in several ways. To an appreciable degree the extended use of electricity for lighting and supplying power has lessened the consumption of gas. The main causes, however, are to be found in the fact that the weather during Christmas week—in striking contrast to that which prevailed in 1899—was unusually mild and open, with an absence of fog and frost, both of which atmospheric conditions necessitate the consumption of large quantities of gas.

Extension of Incandescent Gas Lighting at Hastings.—At the last meeting of the Hastings Town Council, Mr. Allfrey moved the adoption of the report of the Public Lighting Committee, in which they stated that they had had before them a list obtained by the Borough Engineer from the Engineer to the Gas Company (Mr. C. E. Botley) of the streets in the borough which were lighted partly by incandescent and partly by ordinary gas-lamps, and recommended that the ordinary lamps in certain streets in which either the majority or half of the existing lamps were incandescent, should be converted into incandescent lamps—the total number to be so altered being 47. In doing so, he remarked that the use of incandescent lamps made a very great improvement, and he was sure it would be much appreciated by the townspeople in general. The conversion of the lamps recommended that day would cost £35; but they would save on each lamp, so that the net cost was reduced to £28. Several members mentioned other places in the town where more light was needed. Mr. Allfrey said he would be very glad to have incandescent light in every lamp in the borough; but they must go carefully. He would do his best to push the matter forward as soon as possible. The report was adopted. The incandescent gas system is evidently growing in favour in Hastings; and a fresh opportunity has just been afforded to the residents for comparing it with the electric light—the Gas Company having fitted with incandescent burners a "Whitehall" lamp in Robertson Street, close to a newly-erected electric lamp. The rival lamps are attracting some attention.

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Gas-Works Extensions at Milton-next-Sittingbourne.—A Local Government Board inquiry has been held at Milton by Mr. E. P. Burd into an application by the District Council to amend the Provisional Order relative to the gas-works, so as to give the Council additional borrowing powers for the purchase and erection of a new gasholder, the necessary incidental plant, and the acquiring of more land for the holder and buildings.

Gas Explosion in the City.—Just after eight o'clock last Saturday night, the premises of the National Bank, Limited, at No. 13, Old Broad Street, E.C., were the scene of an outbreak of fire, preceded by an explosion. The firemen from Watling and Bishopsgate Streets found that the office on the ground floor of the bank was in flames, and much cutting away work had to be done before the outbreak was successfully overcome. Two men had been at work in connection with the electric light supply when they discovered an accumulation of escaped gas, which exploded. The men were blown a considerable distance, and so seriously injured that they had to be removed to the hospital.

Road-Breaking Expenses in London.—The "Daily Mail" has lately been dealing with the disturbed condition of the London streets, and has published the statement that for the past five years the road-breaking expenses of the three Metropolitan Gas Companies amount to the enormous total of £3,747,154. There are about thirty Local Authorities and Companies who have power to open roads whenever anything is wrong with their electric light cables. They have spent during the past five years £2,554,900. The Water Companies have given the professional road-breakers work to the tune of £2,892,188; though it should be stated that £47,110 was due to frosty weather and consequent damage to mains. The work of disembowelling the streets on behalf of the telephone people for five years has cost £1,369,409. The total expenditure by the principal road-breakers has been £10,563,741.

Progress of the Manchester Gas-Works in the Past Year.—From a review by the "Manchester Courier" of the progress of the various departments of the Manchester Corporation in the past year, we learn that at the Rochdale Road station the re-arrangements rendered necessary by the congested and dangerous condition of these works were advanced. The new meter-house, which came into notice at the time of the disastrous explosion at this station towards the close of 1899, was finished and fully equipped with meters and governors. The machinery required for the new workshops was fixed, and the old machinery is being repaired and moved as from time to time is found practicable. At the Bradford Road station, the whole of the buildings and plant required for the increase of 3½ million cubic feet of carburetted water gas are practically completed. This increase in manufacturing power will be found of great service in any sudden fog or other abnormal demand. The new work in progress at this station is of great importance. A small gas-works, complete in every detail, is in course of erection for experimental purposes. Plant for the manufacture of sulphate of ammonia and sulphuric acid is also in progress. There was no constructional work carried out during the year at the Droylsden station. The inclined retorts there worked well throughout.

A New Reservoir for Gloucester.—The Gloucester City Council have approved the plans and specifications for an additional reservoir adjoining the existing one at Madam's Wood, Newent. In order to provide the cost, application is to be made to the Local Government Board for sanction to borrow £6000.

Gas-Works Extensions at Newtownards.—On the 21st ult., an inquiry was opened by Mr. A. D. Price at Newtownards, respecting an application by the District Council to the Local Government Board for a loan of £3191 7s. 6d. for gas-works extensions. After the opening statement of the Clerk (Mr. W. Heron), the inquiry was adjourned to the 11th inst., when the engineering evidence will be furnished.

South Staffordshire Water-Works Company.—An extraordinary meeting of this Company was held at Birmingham on Friday, at which a proposal to increase the capital of the concern was under consideration. Mr. Frank James, the Chairman, said the Directors had thought it preferable to apply to the Board of Trade for a Provisional Order than to go to Parliament. As showing the necessity for increasing the capital, he mentioned that during the last five years the Company had spent £170,000, and were committed to a considerable additional expenditure. In the period stated, they had extended their supply to 20,000 additional houses, representing 100,000 of the population; and the revenue had increased from £89,000 to £106,600. They were now putting on houses at a greater rate than hitherto; the number added in the five months ended November last being upwards of 2000. It was therefore necessary that they should have more money. He moved that the meeting approve of the application for the Order. Sir Henry Wiggin seconded the motion; and it was carried unanimously.

Gas v. Electricity at Port Elizabeth.—The Manager of the South African Lighting Association (Mr. W. Arnott) does not allow statements adverse to gas to pass unnoticed, however ridiculous they may be, because they might catch the unthinking. A short time ago, the "Eastern Province Herald" was indiscreet enough to express the opinion that "gas dies hard;" whereupon Mr. Arnott pointed out that, on the contrary, it has never been so alive and well, has no thought of death, and is showing no signs of it. He remarked that the best indication of the vitality of a concern or nation is the Money Market; and there it would be found that the best, safest, and surest investments are the gas stocks. He went on to show that while a sum of £96,000,000 is sunk in gas in Great Britain alone, producing a revenue of £37,000,000 (figures which certainly do not furnish evidence of a dying gasp), only £11,000,000 is invested in electricity, yielding a revenue of £1,500,000—the capital being mainly municipal, and in very few cases paying its way. With regard to the cost of the two lights, it appears that gas in Port Elizabeth, with the new Welsbach burner, is eleven times cheaper than electricity, taking the price at Cape Town as a standard. Mr. Arnott, at the time of writing, was about to open gas show-rooms in the Mutual Buildings, where, surrounded by the electric light, he was going to challenge comparison, which he was confident would not be adverse. He was also going to give the residents an opportunity of judging what high-pressure gas lighting can do.

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Water Scheme for South Darley.—The South Darley Urban District Council have adopted a water scheme for the district. It was designed by Mr. Harry W. Taylor, of Newcastle, who has been chosen Engineer to the Council. The cost will be £3500; and the Council will now apply to the Local Government Board for powers to borrow this sum for carrying out the scheme. The district is a small one, forming part of Darley Dale.

Carlisle's Progress as Reflected by the Gas and Water Undertakings.—In a review of the past century, the "Carlisle Journal" says that in 1850 the Corporation took the bold step of purchasing the gas-works which had been established by a private Company. The price paid was £15,489. The works are now valued at £130,000, and have contributed large profits annually to the city exchequer. In 1865, the Corporation bought the water-works which had been established in 1845. The price paid was £31,504. Before the establishment of the Water Company, water was hawked in carts, and sold at so much per pail. These two purchases have grown into big undertakings; and both are now being extended to meet the increasing requirements of the city. The water-works are to be superseded in three or four years by water brought from Geltsdale at a cost of about £150,000; and the gas-works are to be extended very shortly by the introduction of carburetted water gas at a cost of £14,000, as a preliminary to the removal and extension of the coal-gas plant.

Birmingham's Gas and Water Supply in the Fifties.—In an article in a local paper on the growth of Birmingham in the Nineteenth Century, it is remarked: "The commencement of the second half of the century found our town very badly furnished in the matter of public lighting, water supply, and drainage. In respect of lighting, the Birmingham Gas Company had recently secured enlarged powers, but there were street-lamps only in 'the town,' which was a comparatively small part of the borough; and we find that in October, 1852, the Public Works Committee obtained authority to purchase 700 lamp-posts and to carry out the general lighting of the borough with gas as rapidly as possible. As regards water, a small proportion of the inhabitants who could afford the luxury derived their supply from a Water-Works Company which had been in operation since 1831; the rest pumped their water from wells, which were rapidly becoming polluted, or purchased their supply for drinking at so much per bucket from purveyors, who made daily rounds with a barrel upon wheels containing water of guaranteed purity. These water-carts continued to do a good business up to as recently as twenty-five years ago, when the Corporation began to take energetic measures to close polluted wells in the interests of the public health, and tap water became practically universal." The gas and water works were purchased during Mr. Chamberlain's three years' mayoralty, which commenced in 1873; and to the big strides made since then, the columns of the "JOURNAL" have borne witness.

A "record" output of gas by the Tottenham and Edmonton Gas Company was reached on the night of the 24th ult., when 3,225,000 cubic feet were distributed.

For the improvement of the water supply of the district, the Epsom District Council have applied to the Local Government Board for a loan of £2000. An inquiry into the matter has been held.

The Bath Gas Company have reduced the charge to the outlying districts by 6d. per 1000 cubic feet; making the price 3s. By this concession, the charge will only be 3d. in excess of that in the city.

The Colwyn Bay District Council resolved last Friday to give notice to the Gas Company of their intention to apply in the next session of Parliament for powers to purchase the undertaking under the provisions of the Colwyn Bay Gas Act, 1896.

The little gas-works at Bentham are having their productive capacity nearly doubled. A new holder has been completed; and on the 19th ult., gas was turned into it by the Manager (Mr. Richard Sanderson), who has been superintending the work throughout.

It is stated that in the village of Fletching, near Uckfield, several wells have been closed by the Local Authorities in consequence of oil having been discovered in the water. It is imagined that this oil is petroleum, as at Heathfield, not far distant from this place, many traces of deposits occur. There is also, it may be remembered, a supply of natural gas, which has been utilized for some time past for lighting the railway station.

In the village of Simmoyheim, in Würtemberg, a new system of oil lighting has been installed. From a large central reservoir, the oil from which the light is produced is distributed by copper piping to the different lamps, where the petroleum is vaporized by a special apparatus and burner. The Royal Würtemberg Railroads have just concluded a contract for lighting plant on this system at the Cannstadter railway shops at Stuttgart.

At Kirkham, last Friday, a building contractor named Thomas Royles was summoned for having acted as a councillor after having been disqualified by taking part in contracts entered into by the Kirkham District Council. The case for the prosecution was that the defendant fulfilled contracts in the name of one of his workmen. The summons was eventually withdrawn on payment of the costs; but Royles was to resign his seat on the Council.

The Finance Committee of the Bradford City Council last Friday drew cheques to the value altogether of about £168,000 in connection with the purchase of the undertaking of the North Bierley Gas Company. The shareholders are being paid out individually; the largest holdings amounting to between £4000 and £5000. Many of the shareholders are accepting Bradford Corporation stock in lieu of their shares. The purchase will shortly be completed.

It will be seen by an announcement which appears elsewhere that Mr. Alfred Richards will offer for sale by auction, at the Mart, Tokenhouse Yard, E.C., next Tuesday, a new issue of £10,000 of 4 per cent. debenture stock of the Tottenham and Edmonton Gas Company. A sale by tender of £8550 of this stock on the 30th of August last realized an average of £103 18s. 6d.; while £10,000 of similar stock was disposed of by the same method on the 19th of November at £104 11s. 5d. per cent.

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BELLEVILLE	250,000
OTTAWA (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000
ST. CATHERINES (Remodelled)	250,000
KINGSTON, PA.	125,000
PETERBOROUGH, ONT.	250,000
WILKESBARRE, PA.	750,000
ST. CATHERINES (Second Contract)	250,000
BUFFALO, N.Y.	2,000,000
WINNIPEG, MAN.	500,000
COLCHESTER (Second Contract)	300,000
YORK	750,000
ROCHESTER	500,000
KINGSTON, ONT.,	300,000
CRYSTAL PALACE DISTRICT	2,000,000
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HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

SULPHURIC ACID for Sale.
BROTHERTON AND CO., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.
BALE & CO.'S Oxide of uniform quality.
SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

ENRICH your Gas with cheap Benzol,
Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER AND CO., MIDDLESBROUGH.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.
Telegraphic Address: "SATURATORS, BOLTON."

WE GREET THE
NEW CENTURY
WITH WARMTH.

RICHMOND & CO., LTD.,
LONDON,
WARRINGTON,
STRATFORD,
PLYMOUTH,
DUBLIN,
BOURNEMOUTH,
&C., &C.

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1759.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS.
Correspondence invited.

PATENTS FOR INVENTIONS.
Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

PORTER & CO., Gowts Bridge Works,
LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."
[For Illustrated Advertisement, see p. 54.]

AMMONIACAL LIQUOR wanted.
BROTHERTON AND CO., Ammonia Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SADLER & CO., Ltd., Middlesbrough,
Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

GAS TAR wanted.
BROTHERTON AND CO., Tar Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are prepared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.
19, FARRINGDON ROAD, LONDON, E.C.
Telegrams: "LUMINOSITY."

IMPORTANT NOTICE.
TO ACCOUNTANTS OF GAS AND OTHER LARGE COMPANIES.

A GENTLEMAN, who has an Established Agency of Seven Years' standing for the CHANGING OF ENGLISH COPPER COIN, is prepared to take One Thousand Pounds' worth, or more, per week.
Address for Interview and to arrange Terms, J. A., 65, Lancefield Street, WEST KILBURN.

GAS-FITTER seeks Permanency. Well experienced in Compo. and Iron Pipe Work, Gas Stoves and Fires, Service Laying, Meters, &c.
HERBERT, 92½, Widemarsh Street, HEREFORD.

WANTED, a Draughtsman for Gas Plant. Experience in Gas Contractor's Offices indispensable.
Send full Particulars, and state Salary expected, to No. 3621, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS, Water, and Steam Pipe Fitter wanted for a Chocolate Factory at Watford. State Experience and Wages required. Permanent berth to a suitable Man.
Address P., Box 424, Smith's Advertising Agency, 100, FLEET STREET, E.C.

WANTED, for the North of England, two experienced CARBONIZING FOREMEN used to Inclined Retorts and Regenerative Furnaces. Standing Wages 41s. per week.
State, by letter, Age and References to No. 3622, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a thoroughly capable Works FOREMAN for a Gas-Works in the West Riding of Yorkshire, making 150 million cubic feet per annum. House, &c., all free on the Works.
State Wages required, Age, and References to No. 3623, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

KINGSTON-UPON-THAMES GAS COMPANY.

WANTED, immediately, a Senior LEDGER CLERK (one accustomed to Gas Company's Accounts preferred). Salary £125 per annum. Age 25 to 30.
Apply, by letter, stating Experience and Qualification, also Names of two References, to SECRETARY, 16, Church Street, KINGSTON-UPON-THAMES, not later than Tuesday, the 8th of January, 1901.

BRICKLAYER Foreman wanted for a large Gas-Works in Yorkshire. Must be experienced in Retort and Regenerative Furnace Setting, and one who can read Drawings, and has had control of a large number of Men.
Permanent Situation for a steady Man.
Apply, by letter, stating Age, Experience, Wages required, and Reference, to No. 3618, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A SET of Four Second-Hand Purifiers wanted, with an area of not less than 190 feet each.
Offers, with full Particulars, to be sent in the first instance to No. 3603, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ONE Exhauster and Engine complete, and One EXHAUSTER only (12,000 cubic feet per hour each), FOR SALE at the Gas-Works, St. Mary Cray, Kent.
Apply to W. B. MIMMACK, Manager and Secretary.

FOR SALE - 5000 feet Gasholder, equal to new, with Four Columns complete, together with a quantity of Gas Plant. Any reasonable offer entertained.
H. GRAVES, Brandon, SUFFOLK.

RETORTS.

THE Chester United Gas Company have FOR SALE 32 OVAL RETORTS, new, 21 in. by 15 in., 9 ft. long.
Apply to J. C. BELTON, Engineer and Manager, Gas-Works, CHESTER.

FOR SALE—£100 to £5000 of 3½ per CENT. PERPETUAL DEBENTURE STOCK. All Statutory Dividends have been paid during the last 48 Years.
Address H. R. BARNETT, Charlemont, Copthorne Road, WOLVERHAMPTON.

FOR SALE — £100 to £5000 of PerPETUAL 3½ PER CENT. GAS DEBENTURE STOCK. All Statutory Dividends have been paid during the last 48 Years. Capital Account last June was £228,440; Debenture Stock £46,370.
Address H. R. BARNETT, Charlemont, Copthorne Road, WOLVERHAMPTON.

TO BE LET on Hire—
FACING MACHINE, for facing *in situ* Self-Sealing Retort Mouthpieces any shape or size, □, Oval, or Circular.
PULSOMETER, Size No. 5, with 4-in. suction and 3-in. delivery. Steam-Pipe ¾ in. diameter. Discharge 10,000 Gallons per hour.

TO BE SOLD—
GASHOLDER, 30 ft. diameter by 10 ft. deep, with Five Columns, equal to new, only having worked Four or Five Years.
Write J. WRIGHT, Bridge House, BLACKFRIARS BRIDGE, E.C.

WORTHING GAS COMPANY.

THE Company are prepared to receive TENDERS for 350 ORDINARY SHARES of £10 each, ranking for a Standard Dividend of 7 per cent. per annum, subject to the Sliding-Scale.
Minimum Price £15 per Share.
Tenders must be sent in not later than Eleven a.m. Friday, the 18th of January, 1901.
Particulars, Conditions, and Form of Tender obtainable on application to:—
W. FRED VERRALL,
Secretary to the Company.
55, Chapel Road, Worthing.

TENDERS FOR GAS COAL.

THE Magistracy of Copenhagen are prepared to receive TENDERS for the supply and delivery of 50,000 Tons of best GAS COAL from February, 1901, until the end of June, 1901.
The Magistracy reserve the right to divide the Contracts between two or more Contractors.
Further Information and Conditions for the delivery may be obtained on application to Kjobenhavns Belysnings, væsen, Vestre Boulevard, Kjobenhavn B.
The Tenders, sealed and marked "Tilbud paa Kul," to be sent to Magistratens, 4de Afdeling, Lavendelstræde 1, Kjobenhavn K, before the 15th of January, 1901, Twelve o'clock, at which time the Tenders will be opened in the presence of the parties tendering who are in attendance.
THE MAGISTRACY OF COPENHAGEN.
Dec. 27, 1900.

COUNTY BOROUGH OF BURNLEY.

TENDERS FOR PURIFIERS.

THE Gas Committee of the Burnley Corporation are prepared to receive TENDERS for the supply and erection of Two PURIFIERS, 30 feet square, with Iron Roof over same.
Specification with Bill of Quantities and Form of Tender may be obtained on application to the undersigned on payment of 10s. 6d., which will be returned on receipt of a *bonâ-fide* Tender.
Tenders, under seal, endorsed "Tender for Purifiers," and addressed to the Chairman of the Gas Committee, Town Clerk's Office, Town Hall, Burnley, to be delivered not later than Wednesday, the 16th of January, 1901.
JNO. P. LEATHER,
Gas Engineer.
Gas-Works, Burnley,
Dec. 26, 1900.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

COUNTY BOROUGH OF BURY.

TO RETORT AND FIRE-BRICK MANUFACTURERS.

THE Gas Committee are prepared to receive TENDERS for RETORTS, FIRE-BRICKS, and FIRE-CLAY,
Forms of Tender may be obtained on application to Mr. H. Simmonds, Engineer and Manager, Gas-Works, Bury.
Tenders, sealed and endorsed "Tender for Retorts, &c.," to be sent to me not later than Monday, the 21st day of January, 1901.
JOHN HASLAM,
Town Clerk.
Corporation Offices, Bank Street,
Bury, Dec. 21, 1900.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of FIRE-BRICKS, RETORTS, &c., for their various Works.
Full Particulars may be obtained on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Fire-Clay Goods," addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered to me not later than Three p.m. on Thursday, the 10th of January, 1901.
L. C. EVANS,
Town Clerk.
Town Hall, Salford,
Dec. 22, 1900.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 8th day of January next, and will be RE-OPENED immediately after the Half-Yearly Ordinary General Meeting of the Company to be held on the 8th day of February next.
By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., Dec. 28, 1900.

THE GASLIGHT AND COKE COMPANY.

SALE BY AUCTION OF £163,190 ORDINARY STOCK

IN Pursuance of the Gaslight and Coke Company's Act, 1876, and of The Gaslight and Coke Company's (Capital Consolidation) Act, 1898, Notice is Hereby Given that, subject to the approval of the Board of Trade, it is the intention of the Directors of this Company to SELL BY AUCTION, at the Auction Mart, Tokenhouse Yard, in the City of London, on Wednesday, the 16th day of January next, at Two o'clock, p.m.,

£163,190

OF ORDINARY STOCK

of the Company, to be issued under the powers of the Company's said Act of 1898, and to be paid up in full on or before the 1st of February next.
By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., Dec. 28, 1900.

SOUTH METROPOLITAN GAS COMPANY.

SALE BY TENDER OF £80,000 THREE PER CENT. PERPETUAL DEBENTURE STOCK.

MINIMUM PRICE, £94 PER CENT.

NOTICE is Hereby Given, that it is the intention of the Directors of this Company to SELL BY TENDER £80,000 THREE PER CENT. PERPETUAL DEBENTURE STOCK, in accordance with the Provisions of the South Metropolitan Gas Acts, 1882 and 1896.
Particulars of same, with Form of Tender, can be obtained at this Office on application to the undersigned, and Tenders must be sent in on or before Tuesday, the 22nd day of January, 1901.
The Stock will be allotted to the highest bidders, but no Tender will be accepted at a lower price than at the rate of £94 money for each £100 Debenture Stock.
By order,
FRANK BUSH,
Secretary.
Offices: 709A, Old Kent Road,
London, S.E., Dec. 22, 1900.

By order of the Directors of the
KINGSTON-UPON-THAMES GAS COMPANY.

SUDLOW HERRICK AND SONS are instructed to SELL BY AUCTION, at the Sun Hotel, Kingston, on Thursday, Jan. 24, 1901, at Three o'clock precisely, in Lots of £100 and £50 each,

£10,000
NEW CONSOLIDATED ORDINARY STOCK
IN THE
KINGSTON-UPON-THAMES GAS COMPANY.

Particulars and Conditions of Sale may be obtained of the SECRETARY of the Company at the Offices, Church Street, KINGSTON; at the Place of Sale; and of the AUCTIONEERS, 90, Eden Street, KINGSTON.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NEW ISSUE OF £10,000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Jan. 8, 1901, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
ILFORD GAS COMPANY.

£7500 ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Jan. 8, 1901, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
BRIGHTON AND HOVE GENERAL GAS COMPANY.

MR. ALFRED RICHARDS will Sell by AUCTION at the Mart, E.C., on Monday, Jan. 14, at Two o'clock, in Lots,

£20,000 "A" ORDINARY STOCK,

Ranking for a Standard Dividend of 7 per cent., subject to the Sliding-Scale; the last Dividend on the Company's "A" Stock having been at this rate.

Particulars of the SECRETARY of the Company, 5, GT. WINCHESTER STREET, E.C., and 77, West Street, BRIGHTON; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
GASLIGHT AND COKE COMPANY.

ISSUE OF £163,190 ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, Tokenhouse Yard, London, E.C., on Wednesday, Jan. 16, 1901, at Two o'clock precisely, in Lots.

£163,190 ORDINARY STOCK
OF THE
GASLIGHT AND COKE COMPANY.

This Stock, which is issued under the provisions of the Gaslight and Coke Company's Act of 1898, ranks for a Standard Dividend of 4 per cent. per annum, subject to the Sliding-Scale, under which, at the present price of Gas, the authorized rate of Dividend payable is £4 8s. per cent. per annum.

Particulars may be obtained at the OFFICES OF THE COMPANY, in Horseferry Road, Westminster, S.W.; and of the Auctioneer, 18, Finsbury Circus, LONDON, E.C.

By order of the Directors of the
NORTH MIDDLESEX GAS COMPANY.

NEW ISSUE OF 500 £10 ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Monday, Jan. 21, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
COLNEY HATCH GAS COMPANY.

NEW ISSUE OF £4500 ADDITIONAL STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, Jan. 21, 1901, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
WEST HAM GAS COMPANY.

NEW ISSUE OF £11,916 FOUR PER CENT. PERPETUAL DEBENTURE STOCK,

Offering to Trustees and Others an Investment of the soundest character.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Jan. 22, at Two o'clock, in Lots.

Particulars of the SECRETARY of the Company, at the Offices, Union Street, STRATFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.

Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.

Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1805.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc.M.Inst.C.E., F.C.S.

LONDON:
WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

Foolscap 4to, pp. 535, with 239 Illustrations and Steel Plate Engraving (as Frontispiece) of WILLIAM MURDOCH, *Inventor of Gas Lighting. Morocco Gilt, 21s.; Roan Gilt, 18s.*

THE SIXTH (AND CENTENARY) EDITION OF THE

HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

BY

THOMAS NEWBIGGING,
M.Inst.C.E.

LONDON:
WALTER KING, 11, BOLT COURT,
FLEET STREET, E.C.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

HARDMAN & HOLDEN, LD.
ESTABLISHED 1820.

SULPHURIC ACID.

GUARANTEED absolutely free from Arsenic and of excellent Purity. Specially prepared for Sulphate of Ammonia Manufacturers.

Works: BLACKBURN; Miles Platting and Clayton, MANCHESTER.

Head Office: Miles Platting, MANCHESTER.
Inquiries Solicited.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON & COAL CO., LD.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON.

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 „
Ash	2·73 „

For Price, &c., apply to the
WEARDALE IRON & COAL CO., LD.
QUAYSIDE, NEWCASTLE-ON-TYNE.

Now Ready. Net Price: Cloth Bound, 12s. 6d.; Morocco Gilt, 18s.

GAS COMPANIES'

BOOK-KEEPING.

A Practical Treatise on the Keeping of Gas Companies' Accounts.

BY

JOHN HENRY BREARLEY & BENJAMIN TAYLOR,
OF LONGWOOD.

The only complete Treatise on Gas Companies' Book-Keeping ever published.

This book will be found invaluable to those desirous of obtaining a thorough grasp of Gas Companies' Book-Keeping and Accountancy.

A complete set of Transactions are dealt with; the same being entered into the various Books, and posted into the Ledgers. A Model Balance-Sheet is prepared from the set of transactions and postings.

Forms and subsidiary books are illustrated and described. The linking together of the various books is shown at a glance by means of a Chart.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

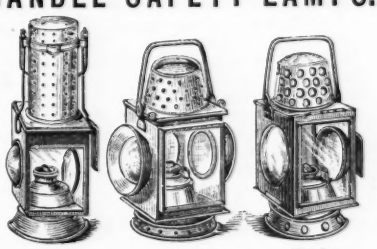
NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

ARMSTRONG'S PATENT
CANDLE SAFETY LAMPS.



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43, MANCHESTER STREET, GRAY'S INN ROAD, W.C.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY

FOR ENGINEERS.

STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

LONDON OFFICE:
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HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.

CHESTERFIELD.

JAMES OAKES & CO.

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

HOLMSIDE
GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power 16$\frac{7}{10}$ Stand. Sperm Candl.
Coke (of good & pure quality) 13$\frac{3}{4}$ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

NITRATE of Thorium and Cerium.
FABRIK CHEMISCHER PRAEPARATE VON STHAMER, NOACK, AND CO., HAMBURG.

HYDRAULIC BLOWER

For blowing Air into Gas Purifiers for the purpose of

REVIVIFYING THE FOULED OXIDE.

Full Particulars on application.

LUXWERKE LUDWIGSHAFEN AM RHEIN.

BOLDON GAS COALS.

Yield of Gas per Ton. . 10,500 Cubic Feet.
Illuminating Power . . 16·9 Candles.
Coke . . . . . 66·7 Coke.
Sulphur . . . . . 0·86 Sulphur.
Ash . . . . . 2·04 Ash.

As per Analysis by
Mr. JOHN PATTINSON, F.I.C., F.C.S.

For Prices, &c., apply to
W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON, NEWCASTLE."

GAS-FITTINGS.

BURNERS
Welsbach Pattern
per 7/6 Doz.

WRITE FOR CATALOGUE.

WHOLESALE FITTINGS COMPANY
80, Commercial Road, London, E.

INCANDESCENT

WELDON MUD
FOR
GAS PURIFICATION.

For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees:
GAS DESULPHURIZATION CO.,
— LIMITED, —
1, FENCHURCH AVENUE, LONDON, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton . . . . 13,155 cub. ft.
Illuminating Power . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . 10,500 cub. ft.
Illuminating Power . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . 10,500 cub. ft.
Illuminating Power . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

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COAL OWNERS, NEWCASTLE-ON-TYNE
OR
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THE DELLWIK-FLEISCHER WATER-GAS PROCESS

For Increasing the Capacity of Coal-Gas Works, also for Incandescent Lighting, Driving of Gas-Engines, and Manufacturing Purposes.

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Plants contracted for within the last Eighteen Months for the following Gas-Works: WEST BROMWICH, KÖNIGSBERG ISERLOHN, LYONS, ERFURT, REMSCHEID, PFORTSHEIM, PLAUEN, BARMEN-RITTERSHAUSEN, NUREMBERG, BRUMMEN,* OSTERFELD,* WARSTEIN,* WIBORG.*

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SMALL TORCH BURNER.

Consuming 3½ Cubic Feet of Gas per Hour.

The highest efficiency of any Burner now on the Market.

Burner with Mantle, 4s.

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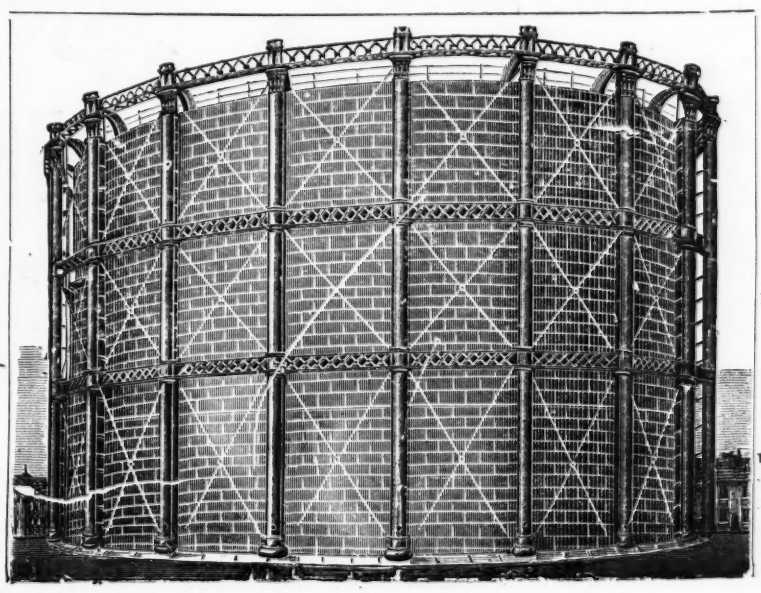

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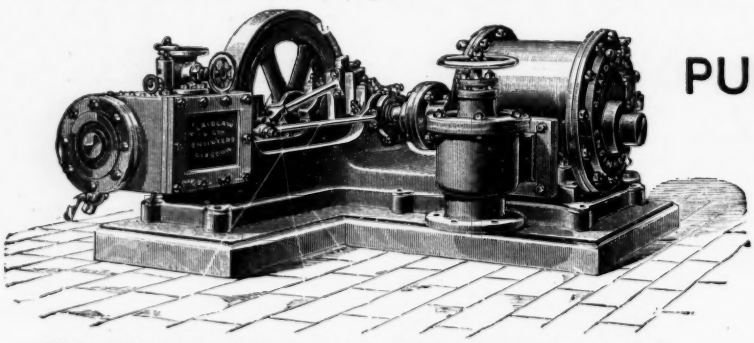

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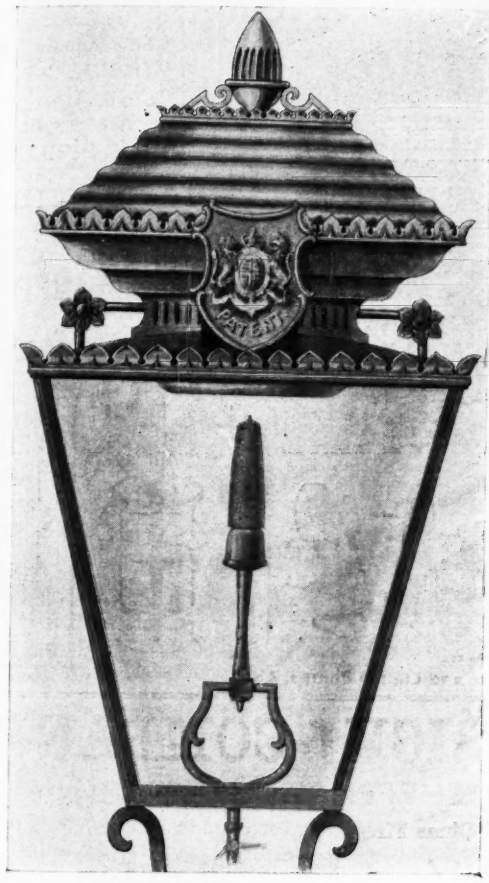
SELF-INTENSIFYING LAMP.



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No Complex Mechanism.

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WITHOUT Compressing Plant, Special Gas-Service, Water Bill, Gas-Engine or other Pumping Appliances, tearing up of Roadways, or interference with existing Service.

The **SCOTT-SNELL LAMP** may be set to give any pressure from **4 inches to 36 inches of Water; 8 inches to 10 inches is usually preferred.**

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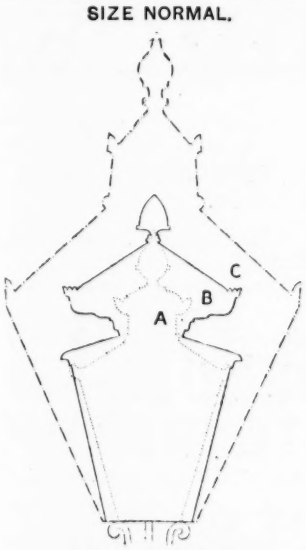
Lanterns supplied with Single, Duplex, or Cluster of Burners.



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A. Ordinary 16 inch Street Lamp.
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HIGH-PRESSURE LIGHTING HAS COME TO STAY.

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Standard
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PULLEYS.

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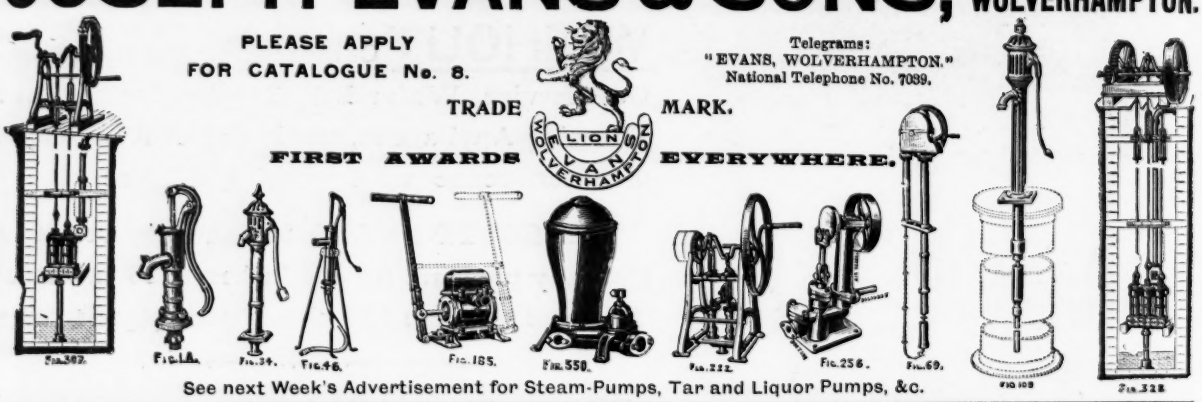

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Our Silica Bricks have gained a high reputation for Unsurpassed Quality in most of the leading Firms in England and on the Continent. Export orders delivered Liverpool, Hull, Grimsby, or the Tyne.

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Manufacture & supply best quality of

Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)

Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.

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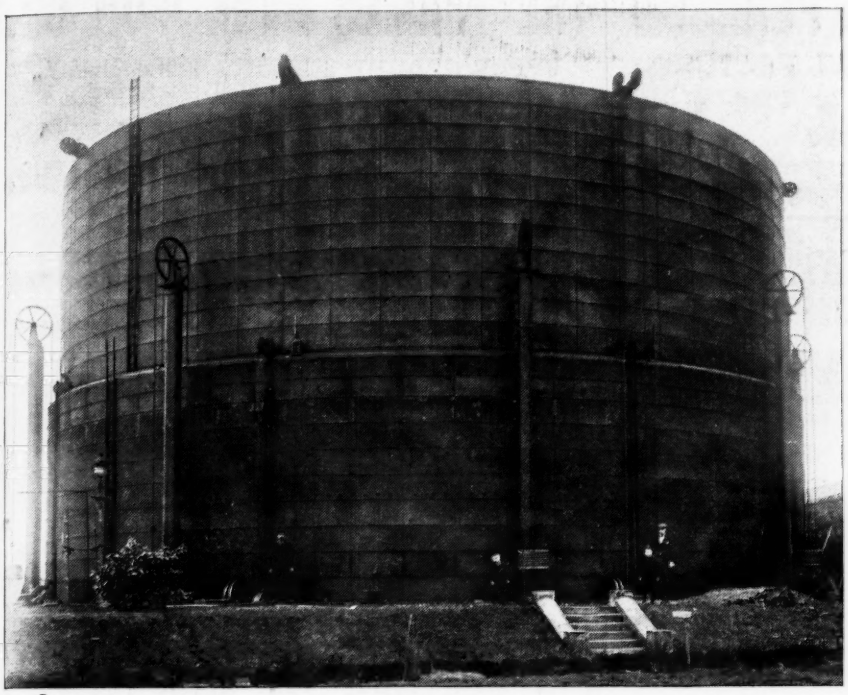

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80 ft. diameter by 24 ft. deep. Both Lifts Cable-Guided. Counterbalance to Outer Lift on old Columns.

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(From a Photo.)

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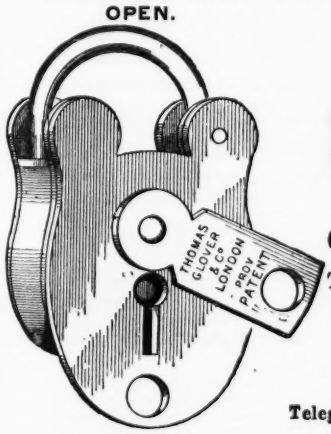

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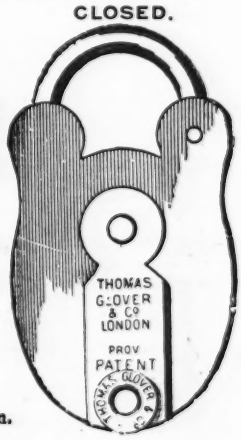

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Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.

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The Caxton Lamp.

Adopted by the Westminster Vestry for lighting Kensington, Knightsbridge, and Westminster.

Fitted with Enamelled China or Steel Reflector. Wind-Proof and Shadowless. A Well-Finished, Strong, and Cheap Lantern.

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SUPPLY FROM STOCK

CAST-IRON RETORTS

AND ALL KINDS OF GAS-WORKS APPARATUS,

SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

Sole Manufacturers of **LYON'S "PATENT" GAS-MAIN SYPHONS**

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THE LARGEST INSTALLATION IN THE WORLD.

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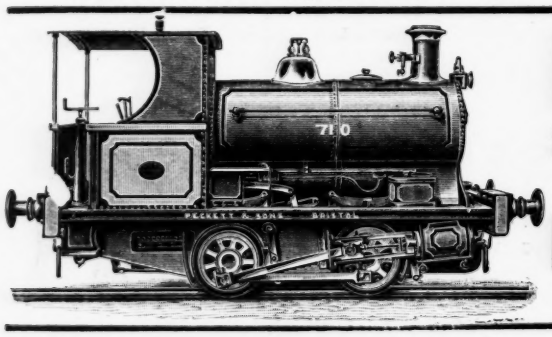

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LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for Immediate Delivery.

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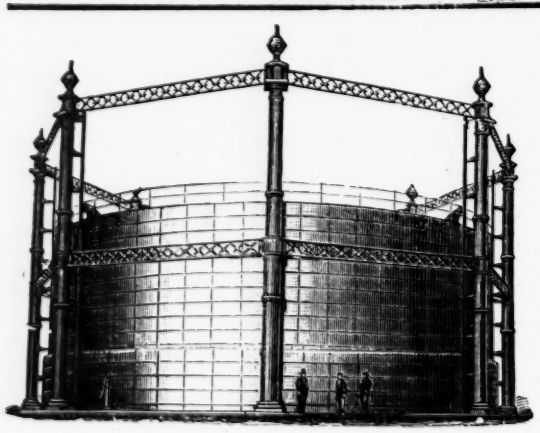

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BEST FIRE-BRICKS, GAS-RETORTS,
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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

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ALL KINDS GAS PLANT
12,100,000 CUB FT CAPACITY.
COMPLETED IN 12 MONTHS
GASHOLDERS
SPECIALITY
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD
IT IS 300 FT DIAR. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
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SUPERHEATER
FOR SULPHATE OF AMMONIA OR OTHER PLANTS.

With this Superheater, the **Temperature of the Liquor can be raised to 190° Fahr. before entering the Still** by means of the Waste Gases only; **Steam and Fuel are saved; the capacity of the Plant is increased; the cheapest unrefined acid can be used; and less condensing power is required.**

Prices and Particulars on Application.

Gas-Generator. Air-Blower.
IMPROVED LEAD-BURNING APPARATUS.

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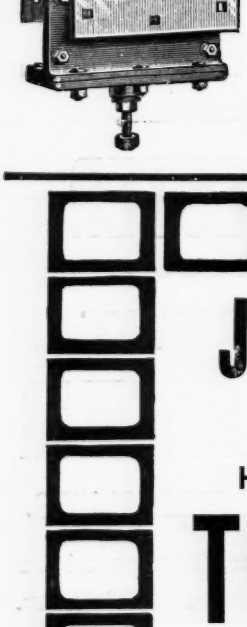

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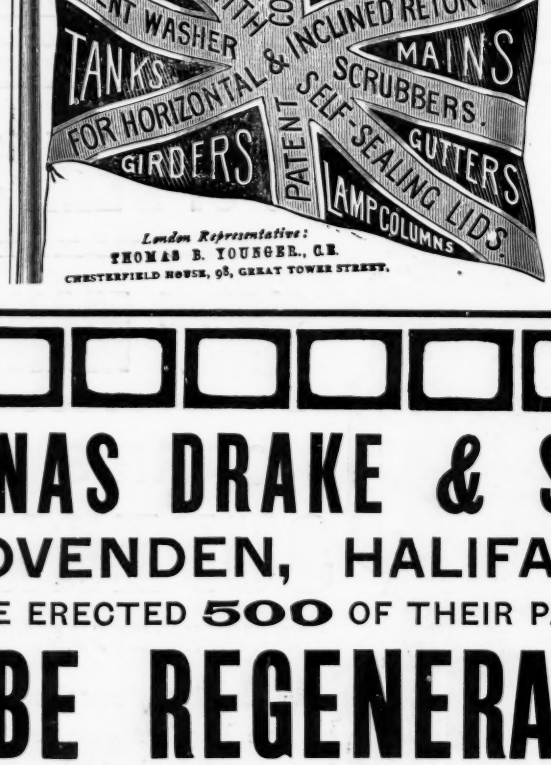

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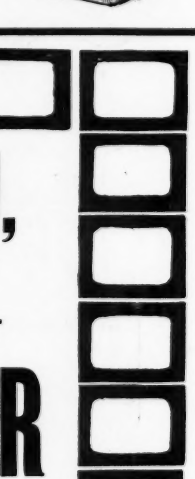

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FURNACES DURING THE LAST **4** YEARS.

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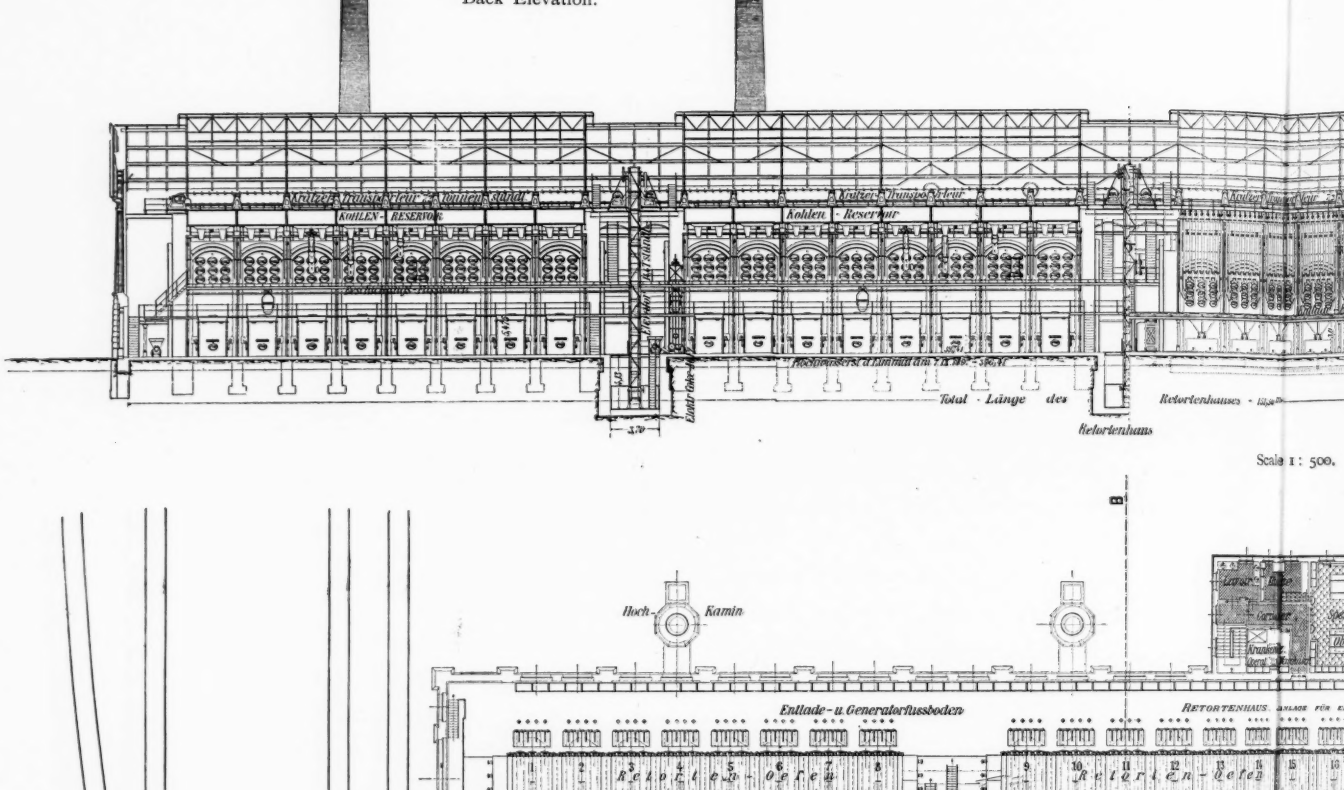
THE NEW GAS-WORKS FOR THE TOW

PLATE II.

LONGITUDINAL SECTION THROUGH THE RETORT HOUS

Back Elevation.



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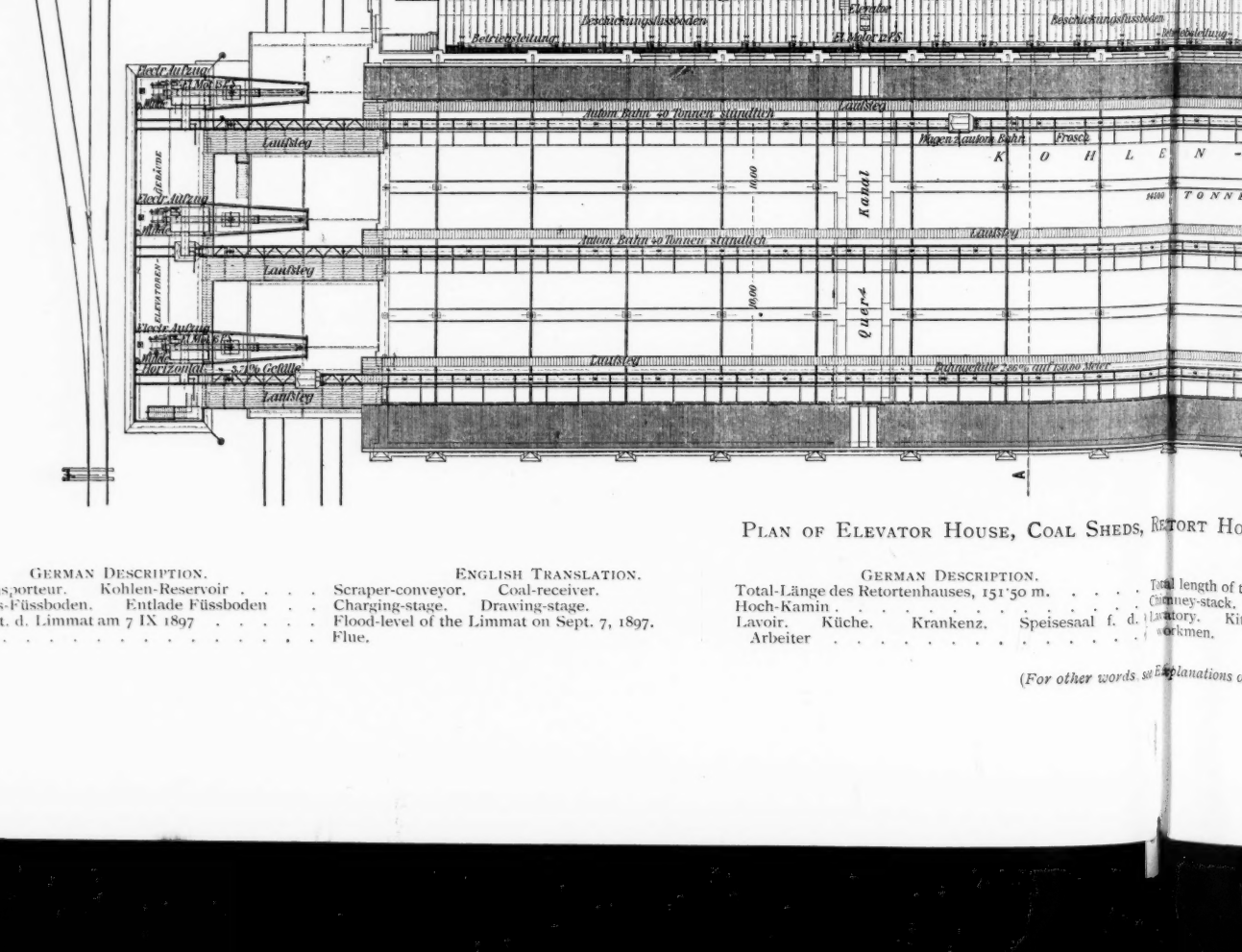


PLAN OF ELEVATOR HOUSE, COAL SHEDS, RETORT HO

GERMAN DESCRIPTION.	ENGLISH TRANSLATION.
Kratzer-Transporteur. Kohlen-Reservoir	Scraper-conveyor. Coal-receiver.
Beschickungs-Füssboden. Entlade Füssboden	Charging-stage. Drawing-stage.
Hochwasserst. d. Limmat am 7 IX 1897	Flood-level of the Limmat on Sept. 7, 1897.
Rauchkanal	Flue.

GERMAN DESCRIPTION.	
Total-Länge des Retortenhauses, 151'50 m.	Total length of t
Hoch-Kamin	Chimney-stack.
Lavoir. Küche. Krankenz. Speisesaal f. d. Arbeiter	Lavatory. Ki workmen.

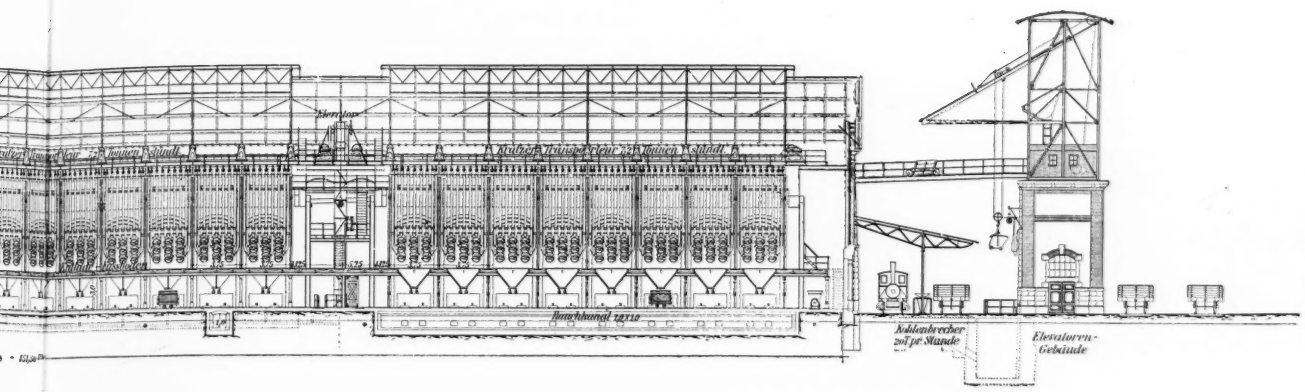
(For other words, see Explanations o

E TOWN OF ZURICH AT SCHLIEREN.

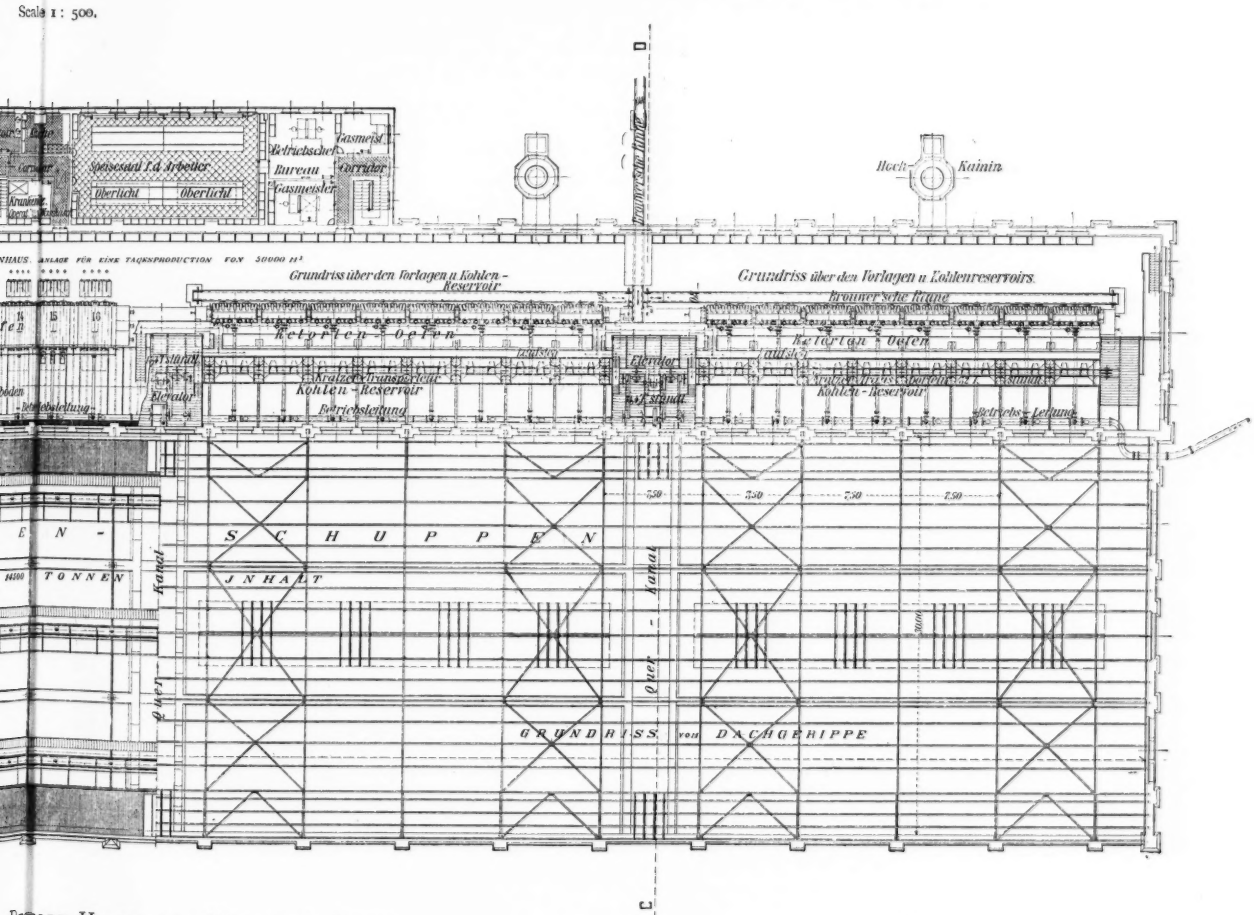
PLATE II.

RETORT HOUSE, WITH VIEW OF THE ELEVATOR HOUSE.

Front Elevation.



Scale 1 : 500.



, RETORT HOUSE, AND WORKMEN'S ROOMS.

ENGLISH TRANSLATION.

Total length of the retort-house, 497 feet.
Chimney-stack.
Lavatory. Kitchen. Ambulance. Dining-room for workmen.

GERMAN DESCRIPTION.

Oberlicht.	Betriebschef Bureau . . . . .
Grundriss über den Vorlagen u. Kohlenreservoirs	. .
Laufsteg.	Wagen z. autom. Bahn . . . . .
Grundriss vom Dachgerippe	

ENGLISH TRANSLATION.

Skylight.	Foreman's office.
Plan on the level of the foul main and coal receivers.	
Gangway.	Waggon on the automatic line.
Plan of the roof-framing.	

(*See Explanations on Plate I.*)

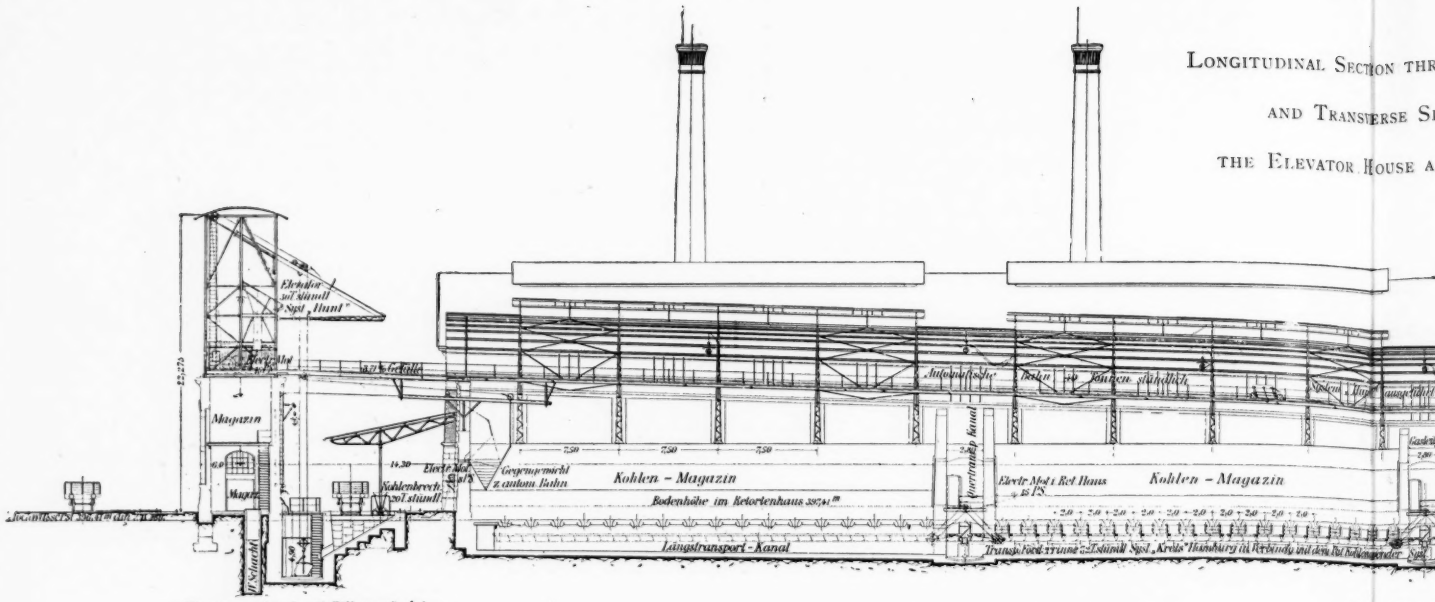
THE NEW GAS-WORKS FOR THE TO

PLATE I.

LONGITUDINAL SECTION THR

AND TRANSVERSE S

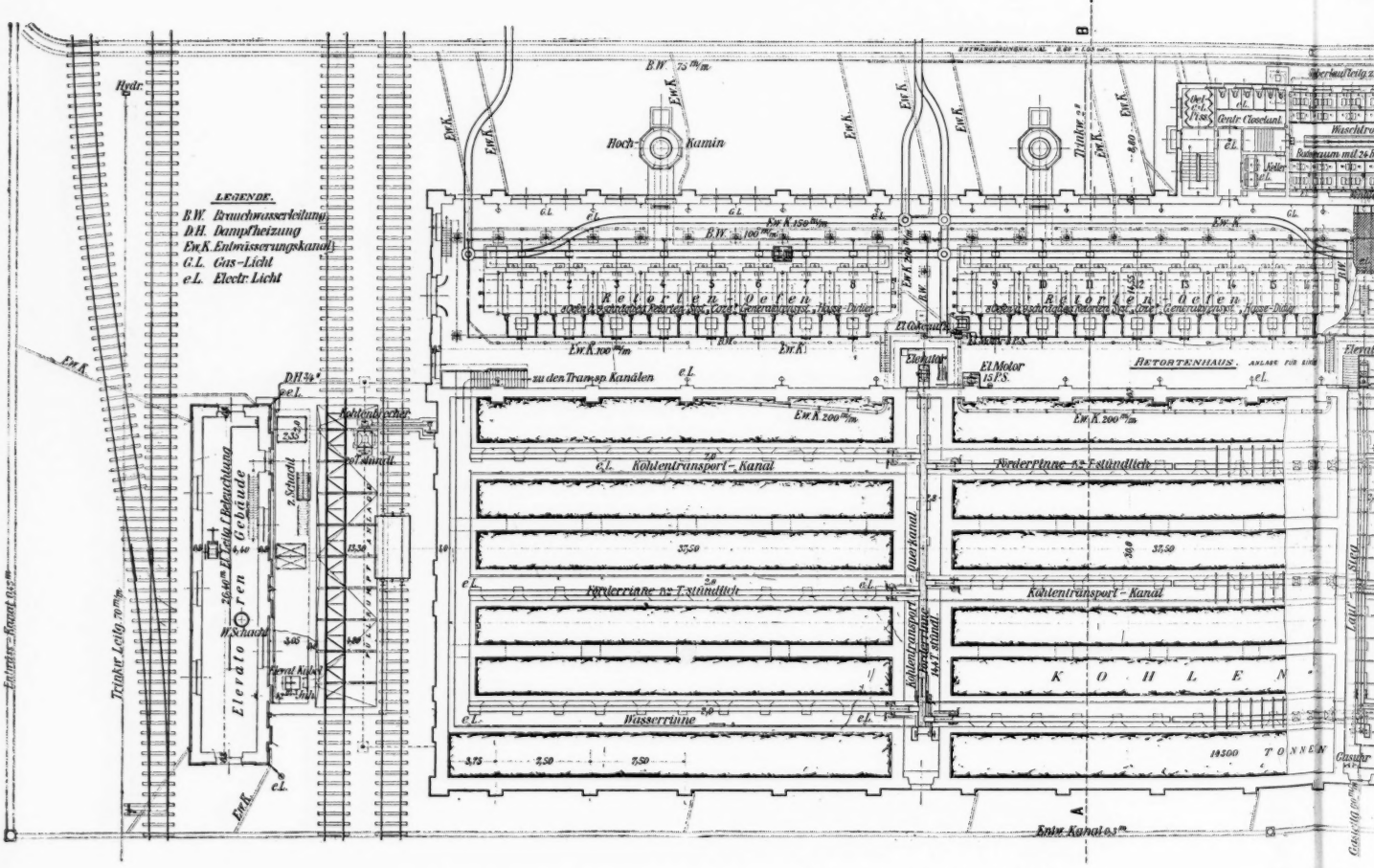
THE ELEVATOR HOUSE A



Elevatorengebäude mit Füllrumpf-Anlage

Kohlenschuppe

Scale



PLAN OF ELEVATOR HOUSE, COAL SHEDS, AND RETORT HOU

GERMAN DESCRIPTION.

Elevator 30 T. stündl. Syst. "Hunt"

Automatische Bahn 40 Tonnen stündlich, System "Hunt," ausgeführt von Pehlig in Köln. Bahngefälle, 2·86%

Betriebsleitung, 56·3% Fall, z. Appar. Haus 450 m/m Lichtw.

Magazin. Gegengewicht z. autom. Bahn

Kohlen-Magazin. Quertransport-Kanal.

Brückenwaage. Bodenhöhe im Retortenhaus

Kohlenbrech. 20 T. stündl.

Längstransport-Kanal. Hochwasser.

Transport Förderrinne 32 T. stündl. Syst. "Kreis" Hamburg, in Verbindg. mit dem Pat. Kohlenspender Syst. "Giroud-Weiss," Olten

ENGLISH TRANSLATION.

Elevator on Hunt's system to deal with 30 tons per hour.

Automatic line to carry 40 tons per hour, on Hunt's system, erected by Pehlig, of Cologne. Fall of line, 2·86 in 100.

Works main 18 in. internal diameter; fall 5·63 in 100, leading to the apparatus-house.

Store. Counterweight for the automatic line.

Coal-Store. Transverse conveyor conduit.

Weighbridge. Level of ground floor of retort-house.

Coal-breaker to deal with 20 tons per hour.

Conduit for longitudinal conveyor. Flood-line.

Conveyor trough on the system of Kreis, of Hamburg, to deal with 32 tons per hour, in conjunction with the patent coal-distributor of Giroud-Weiss, of Olten.

GERMAN DESCRIPTION.

E. W. Kanal. Portier-Hauschen

W. Schacht

Elevatorengebäude mit Füllrumpf-Anlage

Kohlenschuppen, 14,500 Tonnen Inhalt.

Légende—B.W. Brauchwasserleitung

D.H. Dampfheizung

Ew.K. Entwasserungskanal

G.L. Gas-Licht

eL. Electr. Licht

Ueberlaufleitg z. d. Klärkesseln

Centr. Closetanl. Bad.

Waschtrog. Baderaum mit 24 Badezellen

Heizraum. Hoch-Kamin

Entlade- und Generator-Füssboden

Drain.

Water pi

Elevator

Coal-she

Reference

Steam

Drai

Gas

Elec

Overflow

W.C.'s

Wash-ba

(Bath) be

Drawing

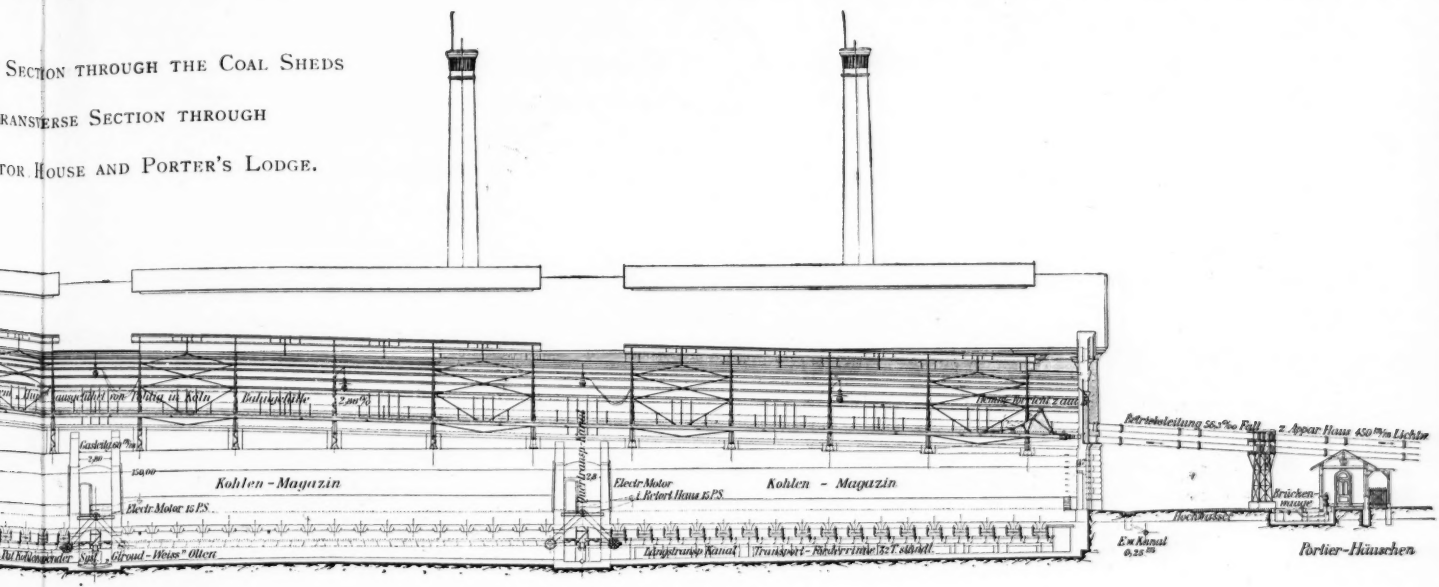
E TOWN OF ZURICH AT SCHLIEREN.

PLATE I.

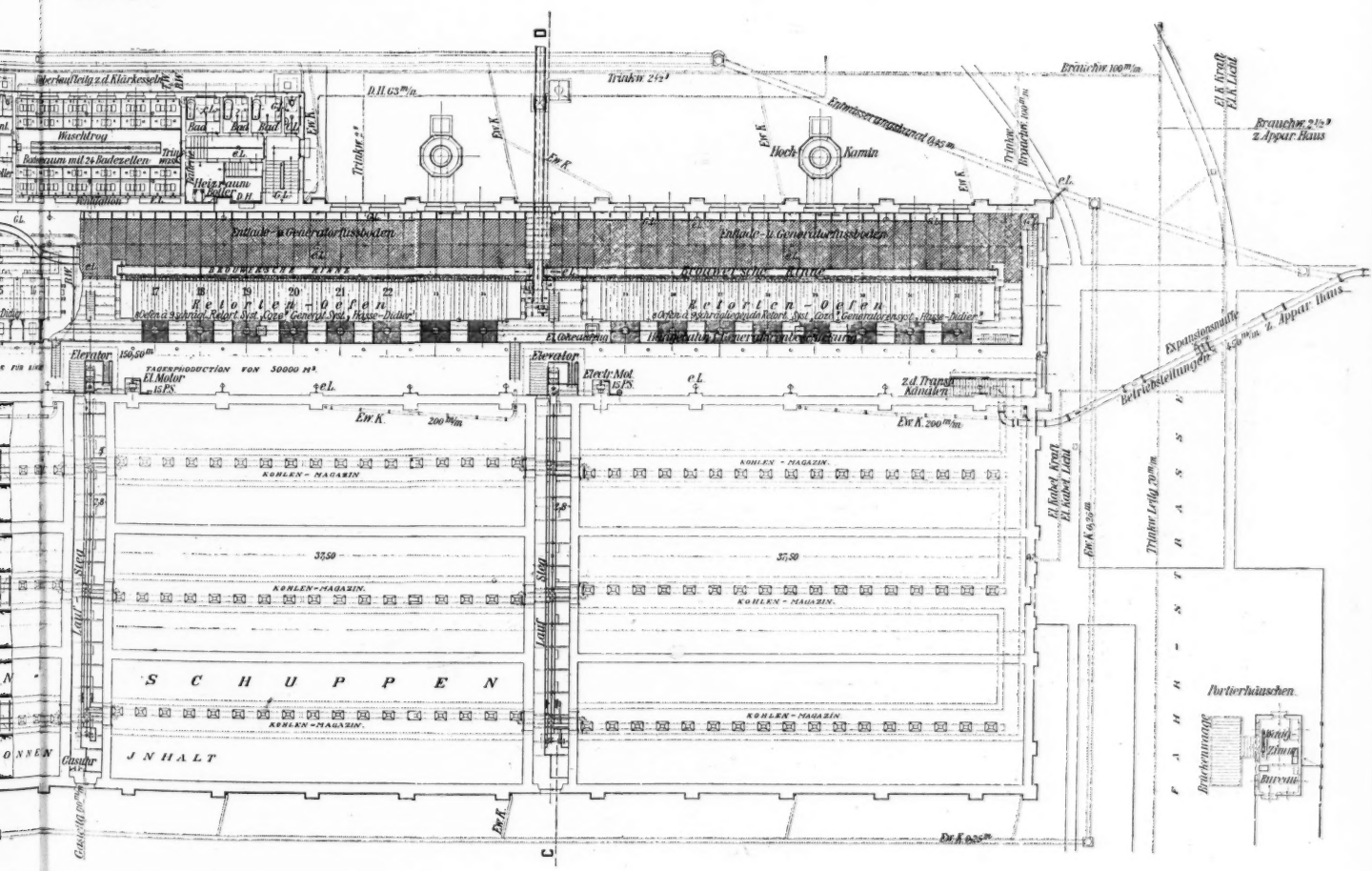
SECTION THROUGH THE COAL SHEDS

RANSVERSE SECTION THROUGH

TOR HOUSE AND PORTER'S LODGE.



Scale 1 : 500.



RETORT HOUSE, WORKMEN'S ROOMS, AND PORTER'S LODGE.

	ENGLISH TRANSLATION.
. . .	Drain. Porter's lodge.
. . .	Water pit.
. . .	Elevator-house, with loading-hopper installation.
. . .	Coal-sheds, to contain 14,500 metric tons.
. . .	*References*—Works water-main.
. . .	Steam-heating pipes.
. . .	Drain.
. . .	Gas light.
. . .	Electric light.
. . .	Overflow to settling-tanks.
. . .	W.C.'s. Bath.
. . .	Wash-basins. Bath-room containing 24 bath-closets.
. . .	(Bath) boiler-room. Chimney-stack.
. . .	Drawing-stage and generator-floor.

GERMAN DESCRIPTION.	ENGLISH TRANSLATION.
Brouwer'sche Rinne	De Brouwer's conveyor-trough.
Retorten-Oefen	Retort-settings.
8 Oefen à 9 schräglieg. Retorten Syst. "Coze;" Generatorensyst. "Hasse-Didier"	Eight beds of 9 inclined retorts on Coze's system; generators on the Hasse-Didier system.
Hängebahn f. Generatorenbeschickung.	Suspension line for transporting fuel to the generators.
Retortenhaus, Anlage für eines Tages produktion von 50,000 m³	Retort-house; plant for a make of 1,765,000 cubic feet per diem.
Zu den Transp. Kanälen. Kohlentransport-Kanal .	To the conveyor conduit. Coal-conveyor conduit.
Kohlen-Magazin. Expansionsmuffe	Coal-store. Expansion-joint.
Betriebsleitungen, 450 m/m z. Appar. Haus. . . .	Works mains, 18 in. diameter, leading to the apparatus-house.
Förderrinne, 32 T. stündlich. Fahrstrasse. . . .	Conveying trough, dealing with 32 tons per hour. Roadway.
3·71% Gefälle	Slope of 3·71 in 100.